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ANNALS *of* SURGERY

Vol. XCVII JUNE, 1933 No. 6

ELECTROSURGERY

A CLINICAL REPORT ON 118 OPERATIONS

By Howard Lilienthal, M.D.

of New York, N. Y.

After an experience in more than 118 operations performed in whole or in part with the aid of electrosurgery, it becomes my duty to make a report embodying my opinion as to the cases in which this method of operating is applicable. I shall present a few brief illustrative histories and some suggestions concerning technic.

Gottesman, Perla, and Ziegler, in a paper published nearly two years ago,* presented the results of a study based upon animal experimentation in which the opinion was given that surgery of this type should not be promiscuously employed. Since then and in spite of this article electrosurgery has been increasing and its results, both immediate and remote, have been not only encouraging but often brilliant.

There are two important points in which it seems to me that the reporters have drawn unwarranted conclusions: First, that primary union is less likely to occur in a wound made by the electric method than in one made with the ordinary scalpel; and, second, that foreign-body necrosis with giant-cell reaction appears and that this is harmful. Farther on I shall discuss these two aspects of electrosurgery.

There are various units on the market for the production of a suitable bipolar electric current. This is not the place to describe and explain the physics of electrosurgery but those who are interested in this phase of the subject are advised to consult the excellent chapter in the recent book by Howard A. Kelly and Grant E. Ward.†

While it is undoubtedly desirable that the surgeon should know everything about his instruments I feel that the knowledge of the application and proper use of a piece of apparatus is more important than the details of its construction and the theory of its function. For example, in the use of the cystoscope it is not essential that the operator should understand all the optical details of the telescope with which he is working, although its general principles must, of course, be known to him.

The Incision.—With the instrument at my disposal in which the oscillations are extremely frequent I have been able to divide the skin by a rapid

* Surg., Gynec., and Obst., vol. li, p. 667, 1930.

† Electrosurgery. Howard A. Kelly, M.D., and Grant E. Ward, M.D., Chap. II, W. B. Saunders Company, 1930.

stroke, the tissues falling apart with no visible evidence of cauterization. Dr. Beverly Chew Smith* in a comparison of the microscopical appearance of sections of healed wounds following incision by knife and by electricity finds that the union is no less firm in one than in the other. Clinically, this is confirmed by my own experience. Upon applying the recently divided tissues to each other after electric incision there is immediate adhesion, and, this being more nearly aseptic than any scalpel wound can be, it is not surprising that rapid linear cicatrization occurs, whether the skin union was secured by metal clips, adhesive plaster, or by sutures. I am assuming, of course, that we are dealing with so-called clean cases. If infection is present it would be unreasonable to expect primary union by any method.

If current-oscillations are slowed down the division of the tissues becomes more and more associated with wider spreading of the area of coagulation and destruction of cells; and if the incision, even with rapid electric oscillations, has been made slowly a similar widening of the area of necrosis will take place and primary union will be less likely to occur.

The question, then, resolves itself into one of technic. We may compare in a similar manner the healing of a slow incision with a blunt knife with the result after the quick stroke of a keen edge.

By the electric method there is, perhaps, a little less bleeding from tiny points than is seen when the steel scalpel is used, but actual spurters, both large and small, must be caught with clamps in the usual manner. The next step in hemostasis, however, is one in which electricity has a great advantage over the ligature. A touch of the slow coagulation-point to the clamp, carefully isolated from all other instruments and from the surrounding walls of the wound will, in a second or two, seal the crushed vascular mouth with a firm eschar. A single wiping after the clamps have been removed should not be followed by hæmorrhage. Any vessel which bleeds after such sponging should be ligated.

The danger of infection by catgut or other ligature material I consider to be greater than that of recurrent hæmorrhage after sterile electrocoagulation. Catgut may harbor organisms as it comes from the tube or spool and, besides, it must be handled in tying the knot—even though with gloved fingers—thus subjecting it to at least one more possibility of infection.

As to the appearance of foreign-body giant cells in the presence of necrotic material it should be noted that these same cells are to be found in the neighborhood of any foreign body such as a ligature. I cannot understand why the mere presence of these cells should be regarded as undesirable. On the contrary, they have to do with the destruction and disappearance of the foreign body, whether this be a tissue eschar or a true *corpus alienum*.

ABSTRACTS OF HISTORIES WITH REMARKS AND SUGGESTIONS

My first case was one of apicloysis for the compression of a tuberculous cavity in the lung. In the method which I employ in this procedure the wound is temporarily

* Paper read at meeting of New York Physical Therapy Society at the New York Academy of Medicine and to be published in the Archives of Physical Therapy.

closed and in a few days is reopened. Compression of the lung is accomplished by daily packing from the outside of the parietal pleura. I felt that here, even if an accident were to occur, the field would be easily accessible and any untoward situation could be remedied. In this instance the operation consisted in an incision beginning near the axilla and running downward and forward for about six inches. This opening was made with a quick long stroke, passing easily through the fatty layer down to the muscle. The pectoralis major was nicked at right angles for the sake of better exposure. The electric scalpel was abandoned on reaching the bony chest-wall, two ribs were resected subperiosteally in the ordinary manner and the intercostal vascular bundles were ligated with catgut. All other vessels were caught with clamps and when a dozen or more were in place each clamp was lifted and was touched with the coagulating current for about two seconds and then removed. There was no bleeding. Extrapleural packings were inserted and the skin was temporarily closed over these packings by heavy stitches to be removed in four days. At the end of this period I found, to my astonishment, the cutaneous wound healed not only primarily but so firmly that it required considerable effort to separate its edges. There was no bleeding when the packings were taken out and subsequent progress was satisfactory, the patient making an excellent recovery.

This first trial eliminated at once the fear that primary union would not take place in a wound correctly made by electrosurgery. Manifestly this was of no importance in the case in hand and it was for this very reason that I had selected it as a test. The fact that there was no bleeding, while very satisfactory, was not conclusive, for, after all, this was only one case, and to establish confidence in hemostasis in electrocoagulation there would have to be further observations.

Twice since then I have done this operation with perfect satisfaction so far as the electric scalpel was concerned.

In addition to the three cases of apicloysis I present a list of other operations:

Thoracoplasty for pulmonary tuberculosis, twenty-eight operations upon fourteen patients. Pulmonary suppuration, twenty-seven operations upon ten patients. Chronic empyæma, eleven operations upon seven patients. Operations upon the chest-wall, seven upon seven patients. Carcinoma of the breast, six operations upon six patients. Carcinoma of the lung, four operations upon four patients. Appendicitis, nine operations upon nine patients. Cholecystectomy, six operations upon six patients. Inguinal and femoral hernia, six operations upon five patients. Operations for ranula, thyroidectomy, sebaceous cyst of the scalp, orchidectomy, osteomyelitis, one case each, eleven in all. In addition to these there were an indefinite number of phrenic neurectomies in which electrosurgery was used for hemostasis only.

Operations upon the Thorax.—These may be divided into two classes: Those in which the chest-wall alone was attacked, and those in which the organs within the thorax were operated upon. I have found without exception that electrosurgery is of enormous value in operations upon the chest-wall only, or as a preliminary to intrathoracic procedures.

Chest-Wall.—*Non-malignant Tumors of Breast.*—Three cases, all extirpation of localized tumors. In none was there any mishap because of electrosurgery. The usual clean healing of the skin was the rule.

Carcinoma of the Breast.—In six cases of this disease, two of them complicated because of the necessity for immediate plastic operation, I found no cause to complain of the electric scalpel. Hemostasis by coagulation especially proved to be a great time saver. Primary union occurred in all these cases except one and here, on account of the unavoidable tension of a plastic procedure, there was necrosis of the edges of the skin for about three inches. Healing was complete five weeks after the operation, however, without further procedure.

There was one hematoma. It formed very slowly—more than a week after operation. This eventually necessitated reopening part of the firmly healed wound, after which there was prompt recovery.

In these mammary carcinomas I did not employ the electric method in dissection near the axillary vessels, but coagulation was employed except when a vessel spurted on wiping it after the forceps had been removed.

In the thorax as well as in other parts of the body I have been led to the conclusion that in sloughing or merely suppurating wounds ligatures might better be used than electric hemostasis. It is worth remarking, however, that even in these cases the entrance wounds when made through healthy skin healed with unusual rapidity.

Chest-wall. Miscellaneous.—The chest-wall alone was operated upon seven times. There was one carbuncle and I excised it with the electric scalpel. Of course, primary union was impossible but healing was rapid and without complications. In another case I had to deal with an area of movable chest-wall, several ribs having been resected with their periosteum by another surgeon long before. There was a small bronchial fistula at the centre of a large area of epithelialized lung. The electric scalpel was used to form skin flaps to cover the lung after its epithelial coating had been dissected away with scissors. The wound was drained at each extremity, but union of the flaps was perfect and final and rapid healing followed.*

Apicolysis.—Three cases. One has already been discussed and the other two showed nothing remarkable.

Thoracoplasty.—In the twenty-eight thoracoplasties there was much less bleeding than I have encountered when the ordinary scalpel was used, and the number of ligatures employed in the checking of spurting vessels was greatly reduced. Indeed, in one case, a secondary thoracoplasty where ten ribs were resected at one sitting, the entire operation was completed without the use of a single ligature. There was primary union. In another instance ten ribs were resected in two different séances without employing a single ligature, and there was perfect primary healing.

In none of the other twenty-six operations had I the slightest regret for having employed the electric method. Occasionally a particularly rebellious spurter had to be tied but, as stated before, the total number of ligatures was very small.

* Surgical Clinics of North America, vol. xii, No. 2.

I have found that when the electrode passes through muscular tissue there is violent twitching, and that this occurs whether the patient is operated upon under local or general anæsthesia. Kelly and Ward (*loc. cit.*) state that this contraction depends upon the number of current-oscillations. I have not had an opportunity to verify this but it would be an important factor in the selection of an electrosurgical apparatus. Of course, the manipulations about the bony structures, including the actual resection of ribs, must be performed with the usual bone-cutting instruments.

I am certain that in a thoracoplastic operation the time is shortened by at least one-quarter, perhaps even more. Healing is fully as rapid as I have found it when using the steel scalpel and ligatures, and the surgeon has an agreeable sense of security from infection. I have lately omitted the individual suture of muscle and fascial layers in these thoracoplasties, contenting myself with a few double silkworm-gut strands which pass through skin, fascia, and muscle. The cutaneous edges are approximated more exactly with metal clips. After all there is little or no tension because a section of the framework of the chest having been removed, the soft parts are actually redundant over a thorax of diminished capacity.

Another advantage of this form of surgery is the greatly diminished or even total absence of post-operative pain in the wound itself, which I imagine depends upon the destruction of the terminal portions of the divided sensory nerves.

Intrathoracic Procedures.—In this list there are twenty-seven operations which were performed for suppurative diseases. I have not cared to employ the electric method here except for entrance through the skin and muscles of the thoracic wall, for fear of conduction of the electric current to the cardiac muscles with danger of arrhythmia, or even death from spasm. I have never seen a fatal case of this kind but I have heard of the accident and can well understand its physiology.

In the twenty-seven cases referred to I have seen no untoward phenomenon which could have been produced by the electric technic. There were four cases of pulmonary bronchiectatic disease with resection of a lobe or a part of a lobe and among them there has been no fatality; this, of course, not being by virtue of electrosurgery alone. It is merely mentioned in passing. The current was not employed within the chest.

Empyæma.—The eleven operations for chronic empyæma were extremely complicated and difficult, all seven of the patients having been operated upon before I saw them, some of them many times. Here, too, the electric incision was of greater importance than the hemostasis, which was usually accomplished by ligation with electrocoagulation as an adjunct. None of the patients has died. Four are long since recovered. One has a tuberculous pleural fistula and was operated upon merely to reduce the size of his empyæma. Two are still under treatment but are rapidly convalescing. It was in one of these cases that I learned the lesson that electrocoagulation may be unsafe in securing hemostasis in suppurating fields. There was a

severe secondary bleeding which demanded reopening of the wound. The patient is now nearly ready to be discharged from the hospital.

Carcinoma of the Lung.—There were four cases. No patient recovered, and in none was life shortened by electrosurgery.

ABDOMEN.—*Appendicitis.*—The skin incisions were made with the electric instrument. The fascia was cut with the scalpel or scissors and the remainder of the operation was completed in the usual manner. All vessels of the abdominal wall except the epigastrics were coagulated instead of being ligated. In seven of these cases there was primary union; in one there was a little exudate which was treated by opening the wound at its extremities and which finally healed before the patient left the hospital three weeks after her operation. In another instance the electric apparatus was not in perfect condition and the incision had to be made slowly. It was necessary to draw the wound edges in contact with adhesive plaster for some days after the skin clips had been removed.

Gall-bladder Disorders.—In six cases the gall-bladder was removed and it was in one of these that I learned to fear electric section of the aponeurosis. There was a separation of the wound six days after operation necessitating complete resuturing. The patient was an emphysematous man with a wide costal arch. While I believe that this accident might have occurred under any technic, I am willing to acknowledge the probability of added danger when an avascular tissue like the aponeurosis has to be divided and sutured.

One of the patients upon whom I operated for appendicitis had to have her gall-bladder removed at the same sitting. Because of faulty functioning of the apparatus the incision had to be made slowly. Here, too, the skin separated over a distance of about one-half inch and the entire wound was treated by firm strapping. Subsequent union was excellent.

In operations within the abdomen I have occasionally made use of the electric scalpel in dividing adhesions or in ablating organs, but I fear the accidental contact of the electrode with a mobile viscus and, therefore, prefer not to employ it as a rule in operations upon the abdominal organs.

Hernia.—Six cases of hernia (one of the femoral variety, the others inguinal) two of which were recurrent, were successfully operated upon with good results. Three of these, however, developed exudates, one of them purulent, evidently due to an infected chromicized catgut ligature. All of the patients, however, recovered perfectly, and since the skin only was electrically divided (not the essential parts of the hernia) I do not feel that the slight accidents could have been ascribed to the electric technic. In no case was the patient kept longer in the hospital than the usual three weeks. I feel that in this region of the body absolute sterilization of the skin is difficult and that the employment of a truly antiseptic knife is a distinct advantage.

Miscellaneous.—Of the eleven cases of miscellaneous operations nothing remarkable is to be reported.

CONCLUDING OBSERVATIONS.—(1) The rapidity and perfection of heal-

ing in cutaneous wounds depends upon the speed with which the incision is made.

(2) Only an instrument with extremely frequent oscillations is suitable for making the incision.

(3) The rate of healing of properly made wounds is equal to that of those made with the scalpel.

(4) The firmness of the immediate adhesion of the cutaneous edges compares well with that of ordinary incised wounds.

(5) Wounds made slowly or with an instrument whose electric oscillations are not sufficiently rapid do not heal as well as those made with the scalpel.

(6) The histological appearance of healed wounds electrically made differs from those in incised wounds but does not indicate tensile weakness, or any other undesirable quality. (Beverly Chew Smith, *loc. cit.*)

(7) An electrically made wound is more likely to be aseptic than one made with the knife.

(8) In checking hæmorrhage from the smaller vessels electric coagulation is much more speedy and quite as satisfactory as ligation. Large vessels should, however, be tied. There is to be found in the text of this paper a description of the application of the clamp and coagulation method applied to spurting vessels.

(9) In sloughing wounds there is danger of recurrent or secondary hæmorrhage no matter what method has been employed. Most surgeons will prefer the ligature in these conditions. Electrocoagulation is absolutely aseptic and no ligature can carry the same degree of certainty.

(10) When local anæsthesia is employed in the section of muscle there is a sensation of electric shock accompanied by contraction of the muscles as they are divided. Therefore, general anæsthesia is preferable in electrosurgery.

Precautions.—In the immediate neighborhood of the heart is is believed that dangerous phenomena may occur because of muscular stimulation of this organ.

No metal instrument in contact with the skin or with other instruments should be touched with the electrode.

The electrode fastened to the patient's arm or leg must be firmly secured. It must not be in contact with wet drapings of any kind for fear of burning.

No electric spark should be employed near an explosive anæsthetic, nor near explosive cleaning fluids.

While working in the mouth electric contact with dental fillings and metal prosthetic appliances must be avoided.

It seems to be the impression among operators inexperienced in this kind of surgical procedure that its only important use is in the extirpation of malignant growths and that it should not be employed when first-intention healing is to be desired. As a matter of fact, electrosurgery as a routine is a distinct advance over the more usual methods.

THE DIAGNOSIS AND OPERATIVE CONTROL OF ACUTE PYOGENIC PHLEBITIS COMPLICATED BY GENERAL SEPTIC INVASION*

By Harold Neuhof, M.D.

of New York, N. Y.

FROM THE SURGICAL SERVICE OF MOUNT SINAI HOSPITAL

An acute phlebitis of venous radicles occurring at the site of a primary infection is a pathological process which is an essential part of the infection but is not ordinarily a clinically recognizable or significant lesion. On the other hand an acute phlebitis, derived from and in close proximity to an infective focus which is usually secondary, is a frequent source of general septic invasion and thus a not uncommon cause of death. When phlebitis occurs the main venous trunk draining the infective or suppurative focus is commonly involved. The incidence of acute phlebitis, and in particular, of acute phlebitis of large venous trunks, in severe pyogenic infections, is perhaps much higher than is generally believed. In an analysis made by Aufses, Hirshfeld and myself of 150 patients at the Mount Sinai Hospital suffering from surgical septicæmia from a great variety of causes† 41 per cent. revealed a phlebitis secondary to a suppurative focus. The lesion was always well-defined, and readily demonstrable either at operation or at autopsy. The phlebitis was the immediate source of the general septic invasion in these cases. It was therefore the most important focus from which surgical septicæmia was derived. The series is sufficiently large and comprehensive to draw the conclusion that acute phlebitis is in fact the most common source of general septic invasion and therefore the feature of septicæmia to which close attention should be given. Furthermore, an important venous trunk, such as the jugular, the axillary, or the external iliac veins, was invaded in every instance in our series. It was the realization of the frequency as well as the ominous significance of the type of phlebitis in question which led to a clinical study of the subject and to the consideration of the possibilities of operative relief.

The classic clinical manifestations of septicæmia derived from pyogenic phlebitis are recurrent chills and fever, and metastatic foci, and the classic bacteriological evidence is a positive blood culture. This pathognomonic triad requires no discussion. It should be pointed out, however, that these absolutely distinctive features portray the full-blown picture. Furthermore, they are not invariably present and do not necessarily characterize the severest cases. Chills occurred in little more than half of the patients in the analysis of the Mount Sinai Hospital material to which reference has already been made. Typical septic fever existed in only 55 per cent. of the cases. The blood culture was always positive and metastatic foci were usually present,

* Read before the New York Surgical Society, November 23, 1932.

† To be published.

only in the patients who died. An additional point of interest is the fact that, contrary to a widely held belief, phlebitis need not be accompanied by a richly positive blood culture. In at least one-third of the cases in our series the number of colonies per cubic centimetre was less than ten. There were several proven cases with negative blood culture.

The clinical picture and the significance of phlebitis of the lateral sinus and of the pelvic veins are known universally. On the other hand the significance of an identical clinical picture indicating the likelihood of phlebitis secondary to a focus of suppuration in adjacent soft parts does not appear to be very generally appreciated. Hence many efforts have been made to eradicate, surgically, relatively uncontrollable processes in the lateral sinus and pelvic veins whereas a much simpler and potentially more efficacious surgical attack on a phlebitis secondary to surface infection can be classed as a rarity. Some remarks are warranted therefore on the subject of phlebitis complicating infection of the soft parts. The recognition of the early stage is vital if operative control is to be attempted. A typical history antedating the phase of phlebitis is that of a distant and often insignificant primary infection, such as an infected blister of a finger or a pustule on the leg. This is followed by regional lymph-node involvement—axillary or femoral, for example—with a varying amount of fever. Sustained fever out of proportion to the degree of the adenitis should lead to the suspicion that infection is extending or has extended to the regional vein—the axillary or femoral in these instances.

Under other circumstances a frank axillary or femoral abscess has developed and has been incised. If fever persists and cannot be accounted for by the local findings, a phlebitis is to be suspected. A phlebitis is the most probable cause of sustained fever if the regional infective or suppurative focus has been adequately eliminated by operation and no other cause is discernible. Should a chill supervene, its repetition does not have to be awaited in order to recognize the existence of a phlebitis. The same statement holds of course for a positive blood culture. In my experience a collection of pus in the soft parts in the region of a venous trunk does not suffice to explain the clinical picture under such circumstances, no matter how large the abscess may be.

A phlebitis and usually a suppurative thrombophlebitis must be postulated and can be tentatively excluded only if the vein is exposed by operation and appears to be normal. A very important feature of the clinical course of the septic invasion from phlebitis from any source, and more particularly from phlebitis secondary to suppuration in the soft parts, is the apparently benign early phase that is often encountered. In not a few instances the patient does not appear ill for the major part of the duration of the general infection and only towards the end, when operative measures would probably no longer be of avail, is the full significance of the situation clinically appreciable.

It is evident from the foregoing that the diagnosis of phlebitis is easy

in the classical group, comprising about 60 per cent. of all cases, and may have to be based chiefly on exclusion in the remaining 40 per cent. There are occasional instances in which the inflamed vein can be felt as such. They are more than counterbalanced by cases in which its existence cannot even be suspected on clinical grounds and in which a working diagnosis of phlebitis must be made empirically.

The pathological process in the infected vein has been the subject of a considerable literature which deals chiefly with the various forms of phlebitis as they are encountered in their final advanced stages at autopsy. Any relationship that may exist between the type and degree of phlebitis and the clinical course has received scant attention. As far as my limited experiences go I have been unable to determine definitely any relationship between the two although I have gained an impression to which reference will be made.

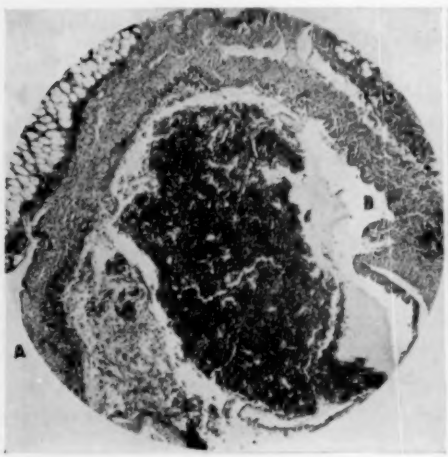

FIG. 1.

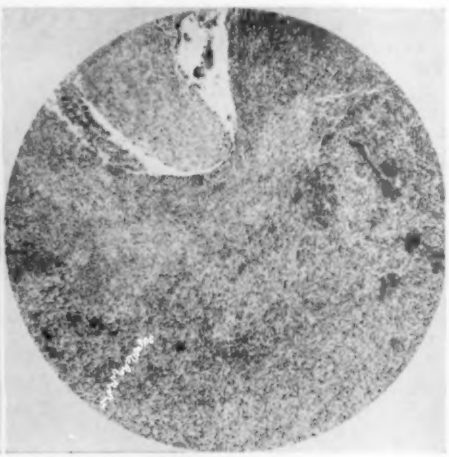

FIG. 2.

FIG. 1.—Cross-section of the axillary vein showing early acute phlebitis. There is leucocytic infiltration of the wall of the vein with scanty bacteria at A, none at B. No thrombosis in any of the sections taken from various parts of the vein. (From Case IV.)

FIG. 2.—Cross-section of brachial vein removed at a later date in the same case. The wall of the vein is greatly thickened and there is diffuse leucocytic and bacterial invasion with purulent thrombosis.

Many observations will be necessary in order to acquire worth-while information on this surgically important question.

The degree of phlebitis which I have encountered at operation ranged from slight changes in the wall of a patent vein to the characteristic white-walled vein expanded about its adherent purulent thrombus. Other varieties noted at operation were an infected vein converted into an almost obliterated cord-like structure, a slightly inflamed vessel containing fluid pus, a whitened, thickened vein containing fluid blood, and a lesion which is essentially an inflammatory or a suppurative periphlebitis.

Details of the microscopical examination of excised specimens of veins will not be given, but three points of surgical moment, gained from the histological study, should be stressed. The first is that the degree of acute

phlebitis, with its invasion of the intimal and subintimal zones by bacteria and polynuclear leucocytes, cannot be estimated accurately by the gross appearance of the vein at the time of operation. The second point is that phlebitis may be found upon microscopical examination at a site at which the vein appears entirely normal in cases of phlebitis not associated with thrombosis. Finally, a severe clinical course may ensue from a phlebitis which is not accompanied by thrombosis. In fact, it is my impression that the macroscopically (gross) thrombophlebitic type may give rise to a comparatively less virulent form of septic invasion although I have some evidence to indicate that the non-thrombosed may be converted at a later stage into the typical thrombophlebitic variety. There is certainly no present means of determining if an acute phlebitis without thrombosis will persist

FIG. 3.

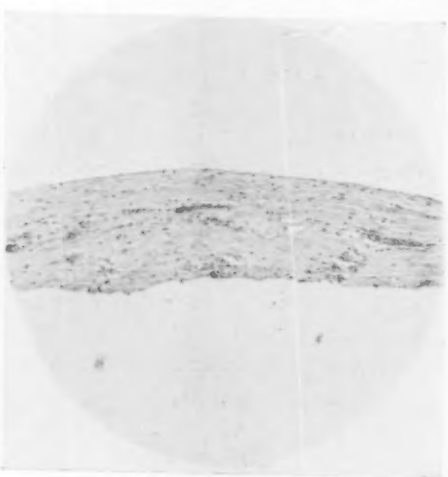

FIG. 4.

FIG. 3.—Purulent thrombophlebitis of the axillary vein. There is œdema, leucocytic infiltration and new-formed vessels in the subacutely inflamed vein, and an adherent purulent thrombus. (Case III.)
FIG. 4.—Normal axillary vein in the section proximal to the site of thrombophlebitis in the previous case.

as such throughout the course in any given case. The bearing of these observations on the question of treatment will be noted.

There can be no doubt of the fact that phlebitis of a surgically accessible and recognizable vein is the feeding focus of surgical septicæmia in many cases. There can also be no doubt of the terrific mortality under so-called conservative treatment although occasional recovery with non-interference unquestionably occurs. It is probably the picture of the great extent of the phlebitic process so often seen at autopsy which leads to a sense of futility as far as a surgical effort at its control during life is concerned. Nevertheless, the otological surgeon, working in a cramped space and on a structure that cannot be safely excised, is not daunted by this picture and achieves tangible results in lateral sinus phlebitis. There is every logical reason for believing that his results as far as saving of life is concerned can at least be matched and in all probability be surpassed in the more accessible general

surgical fields. Whereas he must often temporize by evacuating a thrombus and leaving behind the infected vein, the general surgeon can often remove without danger the vein bearing the lesion. The only striking difference of which I am aware between sinus phlebitis and phlebitis elsewhere is the slower evolution of the clinical manifestations in sinus phlebitis in many instances.

It is because phlebitis associated with general surgical infections usually spreads so rapidly and often leads to death from septicæmia so quickly that the indication for operation is truly urgent. In my opinion the indication exists not only when a definite diagnosis has been made, but also when the probability of phlebitis is seriously considered. There is quite as much justification for exploratory operation for suspected pyogenic phlebitis complicated by general septic invasion as for other suspected lesions. Phlebitis was encountered at operation in every instance and usually to an extent but little suspected in all the cases in my experience. The exceptions I would offer to the indications for operation are the unusual cases in which the clinical picture is of a continuously benign character, a phlebitis involving many veins that cannot be traced, and of course surgical interference with a venous trunk whose patency is essential to life. It would lead too far afield to enter into a discussion of indications for or against more extensive operations which would also include elimination of the phlebitic process. For example, amputation of a limb for septicæmia *versus* drainage of infection and operation for the phlebitis in that limb might be a matter for careful consideration. In such a case, however, amputation, if decided upon, would probably not suffice unless the process in the vein were completely eradicated as well. Conceding the possibility of spontaneous subsidence of phlebitis after the elimination of the causative infection, there is never any assurance of such an issue. The gamble on spontaneous subsidence is a dangerous one when a phlebitis is the source of a septicæmia.

An operative treatment for pyogenic phlebitis complicated by general septic invasion must be based on a plan for complete elimination of that focus. Proximal ligation of the vein should be considered a temporizing method. That that procedure may have to be employed on the pulmonary vein or the portal vein, or on the left subclavian vein because of the thoracic duct, is obvious. However, its advocacy as the principle of treatment is illogical for two reasons; first, the infective and ofttimes suppurative process of and in the vein is left behind to extend peripherally to an uncontrolled extent, and, secondly, the feeding focus may continue to infect the circulation through parallel venous trunks. Proximal ligation of the vein should be classed as an operation which is more apt to fail than to succeed in its purpose, and should be reserved for circumstances in which more effective operations cannot be practised. In the face of a desperate or potentially desperate situation, a temporizing operation has little to commend it when a more definitive one is available. The procedure I wish to advocate is the excision of the vein at the site of phlebitis, the excision to be carried beyond

the visible limits of the phlebitic process whenever feasible. It is difficult to understand the objections to this plan. There should be no fear of œdema resulting from excision of a main venous trunk, because the evidence is clear, I think, that œdema is due to lymphatic and not to venous obstruction. For example, I have excised the entire axillary vein on several occasions, the right subclavian, the common femoral, and the external iliac veins, without observing any œdema of the extremities. Furthermore, there should be no great compunction about the elimination of the vein as a blood carrier since that function will be more or less lost as the result of the more or less obturating lesion within its lumen.

The technic of operation is based essentially on liberal exposure of the vein at the site of phlebitis or suspected phlebitis. After the presence of phlebitis has been established and excision is decided upon, the operative

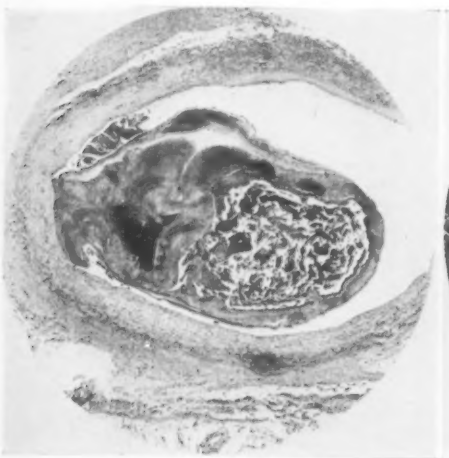

FIG. 5.

FIG. 6.

FIG. 5.—Purulent thrombophlebitis of external iliac vein, showing maximal inflammation of the wall of the vein at the site of the adherent thrombus. The vein was normal at no great distance from the proximal limit of thrombosis.

FIG. 6.—Purulent thrombophlebitis of the internal jugular vein. (Case VIII.) Note that the phlebitis continues below the termination of the thrombus (to the end of the specimen removed at operation).

exposure of the vein is extended beyond the limits of phlebitis whenever feasible. Considerable sacrifice of structures may be required for such exposures, as illustrated in some of the case reports. Special attention should be given to adequate operative exposure proximal to the end of the lesion, because excision is to be performed beyond the limits of the phlebitis. This step has been responsible, I believe, for the fact that phlebitis proximal to the site of excision was not found at autopsy on the patients who died after operation (see case reports) when excision beyond the limits of phlebitis was performed. Furthermore, the blood cultures in these cases, which had been richly positive before operation, became negative or presented scanty growth after excision. Excision from a point proximal to the site of phlebitis has also been the reason for the successful results, in my opinion. Either a serrefine or a temporary ligature is placed on the proximal portion

of the vein before dissection of the vein is carried out. The release of the vein from inflammatory tissue or suppurative areas in which it may be embedded has been difficult on a few occasions.

A plane of cleavage between the vein and surrounding tissues can always be found, however, and the dissection in this plane will isolate the vein for its excision in one piece. The question of the method of dealing with involved branches of the infected venous trunk is an open one. It has not been my practice to dissect them out for any distance because I believe that that dissection is not essential, and in addition would lay open too many tissue planes. It may be argued, however, that the blood-stream might become infected anew by way of these involved tributaries. I know of no evidence to indicate that this can occur unless there are parallel communicating trunks, and in actual practice it has not been noted.

FIG. 7.—Purulent thrombophlebitis of the innominate vein removed at a later date in Case VIII. There is an elevated parietal thrombus. The phlebitis continued below this toward the heart, to terminate at A.

The problem of excision of the vein in the presence of thrombophlebitis (the most common lesion) is a straightforward one, for the microscopical alterations in the vein do not extend very far beyond the visible and palpable site of the lesion. On the other hand the question as to the procedure to be employed when phlebitis without evident thrombosis is encountered cannot be answered unreservedly at the present time. In such instances the microscopical examination reveals a diffused infection of the wall of the vein with minimal or no thrombosis. Infection may be present to the same degree where the vein appears normal as at the site of visible phlebitis. This was the case in one patient whose axillary vein was excised. (Case IV.) Although there was no evidence of further infection from the proximal stump after operation a typical pyogenic thrombophlebitis of the whole brachial vein

developed (see case report). The excision of the axillary vein may have been the cause, or the relatively slight phlebitis of the axillary vein may have been the first stage of thrombophlebitis. With the evidence at hand, excision or incision or any other effort at immediate elimination of the focus cannot be advocated in the treatment of phlebitis without thrombosis. Under the impression that the thrombotic phase would be desirable, tending to localize the zone of phlebitis, I shall in future cases attempt various methods at exciting thrombosis when phlebitis without thrombosis is encountered at operation. One method would be the application of the coagulating current to the wall of the vein at the site of phlebitis, the operation to be terminated by placing a pack snugly against that site. Excision could then be practised several days later if in fact thrombophlebitis was noted at the second exposure of the vein. In the case of the lateral sinus the thrombus could be evacuated in the customary manner. Procedures along such lines should be tried, in my opinion, rather than primary excision or other operative efforts in the presence of phlebitis without obvious thrombosis.

The following case reports comprise the experiences in recent years. The records of earlier operations, especially those performed during the period of the World War, are unfortunately not available. It can be stated, however, that the experiences parallel those described in the case reports. The first two cases illustrate what may be termed the pre-septic phase of pyogenic phlebitis.

CASE I.—*Acute Phlebitis and Periphlebitis of the Dorsal Vein of the Foot. Excision. Recovery.*—(Mount Sinai Hospital No. 336367.) Male, forty-six years old. Admitted with a history of a swelling on the dorsum of the right foot of four days' duration, accompanied by fever. The patient ascribed the lesion to constriction by a tight shoelace. On admission the temperature was 101.2°. There was moderate swelling and marked redness on the dorsum of the foot. The redness extended above the ankle, shading off rather abruptly over the inner aspect of the mid-calf. The appearance suggested erysipelas but was not distinctive. In the midst of the swelling on the dorsum of the foot there was felt a narrow elongated mass which was exquisitely sensitive. This was interpreted as a phlebitis of the dorsal vein of the foot. At operation this vein was found to be the seat of a phlebitis which diffusely involved the vessel for a distance of about two inches. It was surrounded by multiple punctate abscesses. The vein appeared normal beyond the indicated limits. Its branches at the site of phlebitis were apparently not involved. The vein was excised well beyond the limits of the lesion and the wound was packed. The erysipelas-like, widespread redness of the skin subsided immediately after operation. The wound went on to rapid healing.

CASE II.—*Pyophlebitis and Periphlebitis of the Dorsal Vein of the Foot. Excision. Recovery.*—(Mount Sinai Hospital No. 335804.) Male, thirty-five years old. Was admitted with a history of long-standing epidermatophytosis of both feet. Six days before admission redness and soreness of the second toe of the right foot developed. Three days later pain and redness appeared on the dorsum of the foot. A day later pain was noted in the popliteal and femoral regions. The day before admission the patient felt chilly and five hours before admission there was a shaking chill of fifteen minutes' duration. The admission temperature was 103.8° which fell to subnormal the next day. There was a localized infection about the nail bed of the fourth toe with some œdema over the dorsum of the foot. Here there was felt a rather firm, not fluctuant, tender swelling about an inch long and one-quarter of an inch wide. It lay in the long axis of

the dorsum of the foot and directly beneath the skin. There was no overlying increased heat and no lymphangitis. Several femoral lymph-nodes were tender to pressure, but were soft and discrete. In a consideration of the nature of the lesion the interpretation narrowed down to a probable suppurative phlebitis, for there was no evidence of abscess formation or spreading infection and the source of the chill and high fever was apparently derived from the lesion on the dorsum of the foot. The blood culture was negative.

Operation was done on the second day after admission when the temperature was 99.6°. An incision was made over the swelling on the dorsum of the foot and infiltrated tissue was encountered. Several minute suppurative foci were traversed to expose a firm, longitudinal mass. The vein leading into it was dissected free and found to be thick-walled and patent. Two veins leading out from the mass were similarly thick-walled and patent. After these were tied off the mass was excised and the wound packed. Upon cutting across the mass it was found to be a collection of fluid pus within the lumen of a thick-walled vein. The lesion was therefore a suppuration within a vein with multiple areas of suppurative periphlebitis. The progress of this lesion on non-operative treatment would have been in one of two directions: either the gradual evolution of the multiple areas of suppuration about the vein or progressive invasion of the blood-stream via the patent venous trunk communicating with the collection of pus within the vein in the infected field.

The post-operative course was uneventful. There was no post-operative rise in fever and the patient was discharged on the sixth day with a clean, superficial, healing wound. The infecting organism was a hæmolytic streptococcus.

Case III.—*Suppurative Thrombophlebitis of the Axillary Vein. Septic Course Characterized by Unusually High Fever. Excision of Axillary Vein. Prompt Disappearance of Bacteria from the Blood-stream. Recovery.*—(Mount Sinai Hospital No. 313362.) Male, thirty-six years old. Admitted with a ten-day history of chills with fever ranging from 104° to 108.5°. There was an upper respiratory infection at the onset as well as an infected (?) blister on the left thumb. On admission physical examination was negative except for a healed blister of the thumb and a red throat. A left ethmoiditis was found but the lesion was interpreted as not being a suppurative one. During the patient's stay of one week before operation there were several chills followed by rises of temperature to 106.8°, 107°, and 108.2°. Axillary fullness was noted as well as a metastatic focus in the right elbow and in one phalanx of a finger. Blood culture was positive for hæmolytic streptococcus. There was the evidence of a left subpectoral abscess when the patient was seen by me one week after admission. I therefore interpreted the septic state as being derived from a suppurative phlebitis of the axillary vein.

At operation an incision was made across the axilla which was later extended to sever transversely the pectoralis major. A very large multilocular subpectoral abscess was evacuated, the pus being sacculated in several pockets. A shelf of tissue between two of the collections led to the region of the axillary vein. On dividing the shelf inflamed axillary lmph-nodes were found adjacent to the vein. The latter in its second portion was white, thickened, and expanded around a thrombus which was about an inch long. The first portion of the axillary vein presented the tapering off of the phlebitic process and was of normal appearance near the apex of the axilla. The lesion tapered off similarly into the third portion of the axillary vein. A ligature was placed on the first portion of the axillary vein and the vein was then dissected out of the dense, inflammatory bed which agglutinated it to the surrounding structures and particularly to the axillary artery. All the branches of the vein appeared free from involvement. The vein was excised down to its junction with the brachial. Upon opening the specimen the adherent purulent thrombus was found to be about two inches long with mesial rounded and distal tapering ends. The wound was packed.

Microscopical examination of the excised portion of the axillary vein showed a thrombophlebitis with large numbers of bacteria. The sections taken from the proximal

and distal ends revealed normal vein. In this case microscopical examination showed that the phlebitis did not extend far beyond its macroscopical limits.

The blood culture was negative shortly after operation. Improvement in the septic state set in promptly. There was oscillating fever for two weeks after operation due to peripheral metastatic foci, some of which required incision and drainage. Others subsided spontaneously. In particular a pyarthrosis of the right shoulder of bacterial nature as demonstrated by the culture of the aspirated pus (hæmolytic streptococcus) subsided spontaneously. The patient was discharged with healed wounds five weeks after operation and the follow-up revealed normal function of the left upper extremity. At no time after operation was there œdema in this extremity.

CASE IV.—*Acute Phlebitis of the Axillary Vein without Thrombosis. Excision. Suppurative Thrombophlebitis of the Brachial Vein. Excision. Recovery.*—(Mount Sinai Hospital No. 335973.) Male, twenty-eight years old, sustained an injury to the fourth finger of the right hand seven days before admission. He expressed a drop of pus from the site of injury three days later. The following day there developed axillary pain, nausea, vomiting, and diarrhœa. There was high sustained fever and chilly sensations, but no definite chills. The admission temperature was 105°. There was a localized infection of the finger, no lymphangitis, and a tender mass in the right axilla. The patient's physician stated that there had been no lymphangitis before admission. There was limited abduction at the shoulder and the axillary swelling became more obvious when the arm was abducted to a right angle. It could then be more easily examined and was interpreted as a mass of discrete, inflamed lymph-nodes. In the absence of lymphangitis, axillary or sub-pectoral abscess, the sustained fever was ascribed by exclusion to a phlebitis of the axillary vein. An exploration of the axillary mass and of the axillary vein was therefore decided upon. A blood culture was taken and showed no growth.

At operation the day after admission an incision was made across the axilla and carried over the surface of the lateral border of the pectoralis major. The latter was severed at a later stage when approach to the first portion of the axillary vein was desired. Several enlarged lymph-nodes were encountered in the mid-axilla, and one which was unusually large and soft was removed. Its removal exposed the axillary vein in its mid-portion. (The removed lymph-node when cut across showed several areas of necrosis.) Between several of the soft lymph-nodes there were two small collections of thin pus. The portion of the axillary vein exposed by the removal of the enlarged lymph-node was found to be reddened, lustreless, and obviously inflamed. Further dissection of the axillary vein revealed a similar change to a lesser degree toward the apex of the axilla. At the very apex the appearance of the vein was normal. The distal portion of the axillary vein was similarly quite normal in appearance. A ligature was placed on the vein at the apex of the axilla, another on the vein at its junction with the brachial. The branches were tied off and the vein was removed in one piece. The wound was packed. After the vein had been excised some of the contained blood was withdrawn under antiseptic precautions and cultured. The report of the culture was hæmolytic streptococcus.

An erysipelas-like infection about the wound developed soon after operation. The temperature slowly subsided to reach below the 102° level on the ninth day. By the eleventh day there was the fully developed evidence of a phlebitis of the brachial vein. The latter was converted into a localized, tender, cord-like infiltration extending down to the bend of the elbow, surrounded by brawny œdema and redness of the overlying skin. Pus escaped from the axillary wound upon pressure over the upper end of the obviously thrombosed brachial vein. Excision of the brachial vein was done through an incision exposing the full length of the vein. Infiltrated tissue was encountered and the identity of structures was not easy because of this and because of very free oozing. The median nerve was dissected away and the vein exposed. Throughout the limits of the exposure the brachial vein was white, thick-walled, and by palpation could be interpreted as con-

taining a firm thrombus. It was embedded in inflammatory tissue from which, however, it could be readily shelled when the proper plane of cleavage was found. The dissection was continued to within a short distance of the elbow, although there was no evidence of the termination of thrombophlebitis at this level. All the branches were similarly involved. The brachial vein was removed without placing a ligature at the lower end because it was thought that if suppuration supervened at this end pus would be permitted to escape. Upon cutting across the specimen at different levels, it was found that the maximal degree of phlebitis existed at the upper level, but the lesion was advanced throughout. The incision was lightly packed.

The clinical course was satisfactory after excision of the brachial vein. Fever subsided progressively and temperature was normal in a week. The patient was discharged about three and one-half weeks after excision of the axillary vein with clean, granulating wounds. He was seen at follow-up two months later at which time there was full motion at the shoulder- and elbow-joints, and good power.

The microscopical examination of the axillary vein showed the same degree of phlebitis in sections taken from the proximal portion as from the mid-portion, namely, definite but not severe inflammation of the walls with bacterial invasion. There was no thrombosis in any of the sections. The brachial vein showed a severe thrombophlebitis in all sections. It is interesting to note that so severe a thrombophlebitis, accompanied by rich bacterial invasion, could exist in the brachial vein and its branches without corresponding clinical manifestations. This can be accounted for by the fact that the vein was cut off from the general circulation. The branches of the brachial vein, which were involved to the same degree as the parent trunk and which were not excised, did not by communication feed the blood-stream. This feature therefore supports the statement made in the body of the paper to the effect that side branches need not be dissected out unless they communicate with a parallel venous trunk.

Case V.—*Acute Thrombophlebitis of Axillary Vein. Drainage of Axillary Abscess. Excision of Axillary Vein. Cessation of Bacteriæmia. Death from Multiple Abscesses of the Lungs.*—(Mount Sinai Hospital No. 265618.) Male, twenty-four years old. Sustained an incised wound of the left index finger five days before admission. Two days later superficial infection of the finger was noted together with pain in the left axilla. The latter was progressive and generalized pains and fever developed. On admission the temperature was 103.6°. There were enlarged and tender left axillary lymph-nodes. Fever subsided but rose on the fourth day to 104°. Blood culture taken on that day was sterile. Two days later there was a chill followed by rise of fever to 105.2°. A blood culture was taken but operation was proceeded with before the result could be known.

At operation by another surgeon an axillary abscess was evacuated. The day after operation a report on the blood culture was made, 200 colonies of hæmolytic streptococci per cubic centimetre being present. There was a second chill that day and with that chill and the positive blood culture there could be little doubt as to the existence of a pyogenic phlebitis. At operation an incision was made across the axilla severing the pectoralis major and subsequently the pectoralis minor. There was no retention of pus in the drained abscess. Inflammatory tissue was traversed and inflamed lymph-nodes dissected away in order to expose the axillary vein. The latter was intimately adherent to surrounding structures in its mid-portion. Here it was white, thickened, and contained a large thrombus. The lower limit of the phlebitic process was much more obvious than the upper. Accordingly the normal brachial vein was ligated and the axillary vein dissected out in retrograde fashion. Upon traction on the freed vein the upper limit of the phlebitic process could be visualized and a ligature was placed on the normal third portion of the subclavian vein. The branches of the axillary vein at the site of the thrombotic process presented recent thrombi where they were divided between ligatures at some distance from the axillary vein. The other branches of the vein appeared free from phlebitis. The vein was excised in one piece and the wound packed.

Microscopical examination of the vein revealed a severe thrombophlebitis which terminated well within the limits of the specimen. The septic state was maintained after operation, fever ranging between 102° and 105° until death ensued eighteen days later. A blood culture taken the day after operation disclosed two colonies of hæmolytic streptococci per cubic centimetre, a subsequent one, five colonies, and the remaining ones (five in number) were sterile. The maintenance of the septic state was due to a metastatic pleural infection which was drained, a pyarthrosis of a knee-joint which was aspirated, a pararectal abscess which was drained, and presumably to multiple abscesses of the lungs. At autopsy innumerable abscesses of the lung were found. There was as well fluid pus in the phlebitic left brachial vein. The left subclavian vein was found entirely free from phlebitis. In commenting on this case it can be assumed that the multiple abscesses of the lung developed at an early phase of the septic state, before the axillary vein was excised. The excision of the vein succeeded in controlling further invasion of the blood-stream. The phlebitis of the brachial vein can be compared with that noted in the former case and it was therefore probably of no great significance in the maintenance of the septic state.

Case VI.—*Phlebitis of Jugular Vein. Putrid Abscess of Neck. Excision of Vein. Drainage of Abscess. Recovery.*—(Mount Sinai Hospital No. 312108.) Male, forty years old. A gangrenous tonsillar abscess was incised three days before admission. Fever, which had been present before, rose to a high level (106°). A swelling on the left side of the neck developed together with a euphoric state. On the day of admission there was a severe chill of a half hour's duration. On admission the patient was excitable, restless and flushed, profoundly prostrated, and euphoric. The left tonsil was the site of an incised wound with somewhat necrotic margins. There was a pronounced widespread fullness on the left side of the neck extending from the mastoid process down to the root of the neck.

Operation was performed directly after admission with the diagnosis of deep suppuration complicated by a phlebitis of the jugular vein. Under local anæsthesia a free incision was made in front of the sternomastoid which was retracted laterally. The internal jugular vein was exposed and found to be thickened, lustreless and elevated by inflamed lymph-nodes in its mid-portion. In the lower part of the neck it was free from evidences of phlebitis. The vein was therefore tied off at this level. It was exposed above the site of phlebitis, found to be of normal appearance, and ligated. The vein was then excised. Beneath it the carotid sheath was exposed and a foul abscess on and beneath the sheath was evacuated. The suppurative tract led directly to the lateral wall of the pharynx. The tract was split open for adequate drainage and ventilation.

Improvement began shortly after operation, fever soon subsiding and the septic state rapidly disappearing. The anaërobic infection was treated by oxygenation. The patient was discharged with a healing wound eighteen days after admission. In this case the prompt disappearance of the septic state cannot be ascribed solely (or perhaps at all) to the excision of the jugular vein. The evacuation of the deep cervical abscess may have been the definitive step.

Case VII.—*Proliferative Phlebitis of the Axillary, Subclavian, and Innominate Veins. Partial Excision of the Subclavian Vein. Ligation of the Innominate Vein. Death.*—(Mount Sinai Hospital No. 319434.) Male, forty years old. Entered the hospital with a history of onset of sore throat and dysphagia eleven days before admission. There was fever, and on the diagnosis of quinsy an incision was made (but no pus obtained) five days before admission. Fever continued, swelling appeared in the lower part of the neck, patient became irrational and icterus developed. Physical examination on admission revealed a disoriented and confused individual. There was a hepatosplenomegaly apparently of long duration and unrelated to the acute illness. At the root of the neck there was a reddened, indurated swelling interpreted as a deep cellulitis. A blood culture taken shortly after admission was positive (40 colonies of hæmolytic

streptococci to the cubic centimetre) and the patient was obviously suffering from a sepsis derived from a phlebitis.

At operation an incision was first made over the swelling at the root of the neck and nothing other than devitalized inflammatory tissue was encountered. The internal jugular vein was exposed and presented no significant changes. Further exploration behind the clavicle disclosed the same type of devitalized tissue which was now met in the region of the subclavian vein. The latter was then exposed and found to be converted into a greatly thickened, cord-like structure embedded in inflammatory tissue. The dissection was continued to expose the axillary vein which was also the seat of a similar process and similarly embedded in devitalized inflammatory tissue. No pus was encountered. The proximal end of the phlebitic process was not exposed for two reasons: first, because of the fact that the thoracic duct was presumably in the operative field, and secondly, because suppuration was not encountered and the lumen of the vessel appeared obliterated. A section of the lateral portion of the subclavian vein together with an adjacent part of the axillary vein was removed. There was no bleeding from either end although ligatures were not applied. At the end of the operation the dictated comment was that the situation was not clear and that the plan was to proceed with an effort at reaching beyond the central end of the phlebitis if the septicæmia continued. Microscopical examination revealed a subacute proliferative type of phlebitis without thrombosis. A blood culture taken the day after operation disclosed a vast increase in the number of colonies of hæmolytic streptococci (more than 400 colonies per cubic centimetre). Fever was low. Two days after the first operation the effort was made to ligate the innominate vein beyond the limit of phlebitis. Sections of the first and second costal cartilage were removed together with the mesial two inches of the clavicle, through a curved incision. The anterior mediastinum was entered and the cord-like subclavian vein was exposed. It was followed into the mediastinum and the tissues overlying the innominate vein were separated. The vein was found to be a stiff white tube enveloped in inflammatory tissue. It was followed to within a short distance of the pericardium at which site the inflammatory process tapered off. A ligature was placed at the level of termination of phlebitis and securely tied. Excision could not be performed because of the inevitable damage to the thoracic duct as well as the unsatisfactory condition of the patient. The wound was packed. The patient's condition did not improve after this operation and he died with the picture of continuing infection.

At autopsy the innominate vein was found to be normal at and proximal to the site of ligature. Distally the innominate and the unexcised portions of the subclavian and axillary veins were the seat of the same type of phlebitis which characterized the excised specimen. There were no metastatic foci. The source of the phlebitis in the axillary, subclavian and innominate veins could not be definitely determined. Attention is called to the evidence that the inadequate first operation was not only followed by continuation of the septic state, but also by its intensification, if the vast increase in colonies in the blood-stream can be accepted as a guide.

Case VIII.—*Thrombophlebitis of Lateral Sinus and of Jugular Vein. Evacuation of Thrombus from Lateral Sinus. Excision of Jugular Vein. Continued Bacteriæmia. Excision of Innominate Vein for Phlebitis without Thrombosis. Cessation of Bacteriæmia. Death from Meningo-encephalitis.*—(Mount Sinai Hospital No. 322025.) Male, fourteen years old. Admitted to the otological service with a five-day history of right-sided otitis followed by the development of mastoiditis. At operation shortly after admission a suppurative mastoiditis was encountered and there was as well a peri-sinus abscess which was drained. Fever was sustained at a high level after operation and symptoms of severe meningeal irritation appeared. There were no chills. Blood culture was positive (hæmolytic streptococcus).

Four days after the mastoidectomy tenderness and a cord-like resistance were felt along the course of the jugular vein The diagnosis was a phlebitis extending down the

vein to an undetermined extent. Operation on the jugular vein was proceeded with. The vein throughout the operative field was thickened and whitish, filled and emptied with respiration, but contained no blood. Through its wall there could be felt a thrombus terminating in the lower part. The vein was freed and tied off at the root of the neck well beyond the limit of the thrombus. It was then dissected out to within a short distance of the mastoid process. The specimen showed a thrombus about an inch long in the mid-portion of the jugular vein. The otological surgeon then proceeded with the treatment of the sinus phlebitis, the operation consisting in opening the sinus and removal of its contained purulent thrombus until free bleeding was obtained from both ends.

Microscopical examination of the excised jugular vein showed that acute phlebitis existed at the lower end of the vein well beyond the limit of the adherent infected thrombus. The clinical picture of severe meningeal irritation persisted after operation and the blood culture remained positive. Fever was sustained, somewhat irregular, and there were no chills. The spinal tap was negative for bacteria although there were the evidences of an inflammatory reaction in the meninges.

A week after the operation on the jugular vein and lateral sinus, the continuing sepsis was interpreted as referable to uncontrolled phlebitis below the limit of the jugular vein. Accordingly, operation was performed for the purpose of exposing the stump of the jugular and the course of the innominate vein. The incision began at the root of the neck, extended downwards in a curved fashion across the inner third of the clavicle over the anterior chest wall. The sternoclavicular joint was entered and was found to contain a small amount of pus. The proximal third of the clavicle was laid bare and excised with a Gigli saw. The anterior mediastinum was then entered. The innominate vein could not be identified at once and accordingly the stump of the jugular vein where it had been ligated was found. It was thick-walled and whitish and was employed as a guide for the exposure of the innominate vein. The veins entering the latter presented no abnormality and they were tied off as they were met. The junction with the subclavian vein was exposed and the subclavian vein was found to be normal. Exposure of the innominate vein showed it to be white-walled and firm in its upper portion. In its lower, that is the proximal portion, it was of normal appearance. The subclavian was then tied off and the innominate vein removed after ligation at its normal portion. The specimen was a section of the innominate vein one and one-half to two inches long which showed on gross examination a thickened wall but no thrombus.

Microscopical examiation revealed a typical phlebitis of the innominate vein without thrombosis. It terminated well within the limits of the specimen. The clinical course after operation was that of sustained fever for three weeks and death. Blood cultures after excision of the innominate vein were negative. A sacral abscess at the site of pressure necrosis was incised. The signs of meningeal irritation continued. No metastatic foci could be discerned. Death appeared to be due to a continuing cerebral focus rather than to septicæmia.

At autopsy the distal portion of the lateral sinus was bound down to the surrounding tissues in one thrombotic mass with obvious evidence of surrounding inflammation. The meninges were dulled and the ventricles were somewhat distended. The cerebral lesion was interpreted as a productive (toxic) meningo-encephalitis. This appeared to be the cause of death. The stump of the innominate vein was healed and there was no evidence of phlebitis in the remaining portion. In this case septicæmia was not controlled by evacuation of the thrombus in the lateral sinus and excision of the jugular vein, but was definitively controlled after excision of the innominate vein beyond the limit of phlebitis.

SUMMARY.—Pyogenic phlebitis derived from a regional infective focus is a frequent source of general septic invasion (surgical septicæmia).

When phlebitis occurs, the main venous trunk draining the infective focus is usually and obviously involved.

The classical clinical manifestations of septicæmia derived from pyogenic phlebitis are not always present and do not necessarily characterize the severest cases.

There is no definite relationship between the clinical course and the type and degree of phlebitis.

Various forms of phlebitis are described. For clinical purposes they can be grouped into acute phlebitis without thrombosis and acute thrombophlebitis, the latter being more frequently encountered.

The results obtained by attempts at operative control of phlebitis of the lateral sinus can at least be matched in general surgical fields, but the effort is rarely made.

Special attention should be given to the early diagnosis and operative control of phlebitis secondary to infective foci in adjacent soft parts.

Barring some specified contra-indications, exploratory operation should be performed when phlebitis is diagnosed or seriously suspected as the source of general septic invasion.

Excision of the infected vein, beyond the visible limits of phlebitis whenever feasible, is advocated as the operation to be performed. This procedure is a precise one when thrombophlebitis exists, but probably requires modification in the presence of phlebitis without thrombosis.

The technic of operation is based essentially on full exposure of the lesion in the vein.

The best results can be anticipated with early diagnosis and operation but results can also be obtained when an advanced phlebitis and metastatic foci exist.

MULTIPLE MYELOMA SIMULATING HYPERPARATHYROIDISM *

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We wish to present data concerning a patient afflicted with multiple myeloma which in many respects simulated hyperparathyroidism. The correct diagnosis was made after biopsy with microscopical examination of tissue.

Multiple myeloma is a neoplastic disorder of unknown etiology. Approximately 60 per cent. of the cases occur between forty and sixty years of age.[7] The significant clinical findings in multiple myeloma usually consist of pain occurring at irregular intervals, bone tenderness, generalized weakness and secondary anæmia. Bence-Jones protein has been found in the urine in less than half the cases of myeloma[11] and it may be continuous or periodic and in scanty or large amounts. Bence-Jones proteinuria may also occur in myxœdema, leucæmia and carcinoma.[3] Recurring fever has been observed with myeloma, although the temperature is usually normal.[3] Pathological fracture may occur in later stages of this disease.

The significant röntgenological findings in multiple myeloma are multiple punched-out and mottled areas in the bone, without distortion of the cortex, particularly in the spine, ribs, skull, sternum, clavicle and pelvis.[2]

Histological study of multiple myelomas usually reveal them as one of two types, although frequently both types of cells may be present. The larger group is the so-called plasma-cell type which is composed in large part of cells resembling plasma cells.[3] The other group is the myelocyte type[2] composed for the most part of cells resembling myelocytes. Some observers consider the latter group as more malignant than the former.

Hyperparathyroidism as a disease entity is a recent exploit in medicine. Erdheim apparently was the first to attempt to associate osteitis fibrosis cystica with parathyroid tumor and to Mandl (Vienna, 1926) belongs credit for the first successful parathyroidectomy.[8] Gold's successful case followed two years later. Then in rapid order the disease entity was established, through publications by European and American observers. This chronological development has been shown admirably in the excellent study by Donald Hunter.[8]

The common symptoms and findings in hyperparathyroidism are progressive weakness, muscle, joint and vague bone pains and attacks of abdominal pain and vomiting, with secondary anæmia, weight loss, polydypsia and polyuria.[12]

The significant blood findings consist of hypercalcæmia and hypophosphatæmia.[12] The urine contains an abnormal amount of calcium due to a negative calcium balance. There is a marked diffuse rarefaction of the bones

* Presented before the Association of Residents and Ex-residents of The Mayo Clinic, Rochester, Minnesota, October 13, 1932.

as evidenced by röntgenograms; and multiple cysts and tumors of bone are frequently encountered.[8]

Case Report.—A farmer's wife, aged fifty-two years, came to us because of extreme generalized weakness and pains in her left side. Her past history was essentially negative except for a severe attack of influenza in 1918, and a nervous breakdown in 1923. Early in January, 1932, she became almost bedridden because of marked weakness and abdominal distress. One of our group (Dr. C. E. Caylor) saw her at her home and brought her to the hospital for examination and observation.

Physical examination revealed a talkative, bedridden woman, not acutely ill, able to move her head from side to side but unable to raise it from the pillow. She was unable to move quickly and had marked generalized muscular weakness. In rising from a prone to sitting position she had to get up sideways and "climb up on her knees," as it were, in much the same manner as a patient afflicted with progressive muscular dystrophy. Furthermore, gentle but firm pressure also caused pains of the muscles in various parts of the body. There was

Fig. 1.

Fig. 2.

Fig. 1.—Röntgenogram of pelvis illustrating the areas of rarefaction most marked in the right femur and pelvic bones.

Fig. 2.—Röntgenogram illustrating areas of rarefaction in the skull.

marked tenderness along the left lower costal margin which extended back to the costovertebral angle. The heart was not enlarged, there was a soft systolic murmur heard loudest in the second and third left interspace, and not transmitted. The laboratory findings were as follows: The hæmoglobin was 83 per cent., red count 4.07 million, white count 5,900. The blood-pressure was 130/76. The urine was essentially negative. The Kline was negative. An electrocardiograph revealed a sinus tachycardia with marked left ventricular preponderance, and an R-T interval of 0.24 second (measured from beginning of the R wave to the crest of the T wave, apparently as measured by Spaulding[14]). The gall-bladder functioned normally (Graham-Cole method). The basal metabolism rate was 0.

Because of this constant pain radiating to the back and this marked muscle pain, a röntgenogram of the back was taken. In this picture, the spine and ribs revealed an osteoporosis with numerous round to oval shaped rarefactions. In view of this unexpected finding, röntgenograms were taken of the head, long bones, pelvis and hands.

(Figs. 1 and 2.) All of these bones revealed a similar picture, with the lesions most marked in the vertebra, ribs, skull and pelvis. These findings demanded a differential diagnosis with special consideration of multiple myeloma, hyperparathyroidism, osteomalacia and metastatic carcinoma. The following table reveals the various blood-calcium and phosphorus levels:

TABLE I

Date	Blood Calcium	Blood Phosphorus
2/ 6/1932	8.5	
2/11/1932	15.0	3.5
2/15/1932	11.5	3.5
2/16/1932	15.0	3.5
2/17/1932	13.0	3.5
2/20/1932	19.5	3.5
2/29/1932	10.0	3.0
3/ 2/1932	11.5	4.0
3/ 4/1932	15.0	3.5
3/ 8/1932	15.0	3.5
3/22/1932	11.0	3.5
4/14/1932	11.5	3.5
5/30/1932	8.0	3.5

Since the röntgenographical and the first blood-calcium finding were suggestive of osteomalacia, as well as multiple myeloma, the patient was given increasing amounts of quartz light therapy plus viosterol and calcium lactate, for two and one-half weeks with no clinical improvement. A second blood-calcium determination shortly after this treatment was started revealed a high blood calcium. Evidently the first determination of blood calcium (using a different method) was not satisfactory since the blood calcium remained high for six to eight weeks after discontinuing the use of calcium lactate and viosterol.

The diagnosis was finally "simmered" down to one of the two conditions, either hyperparathyroidism or multiple myeloma. A careful examination of the neck revealed no palpable enlargement in the region of the thyroid gland. A biopsy was decided on and the right twelfth rib removed. (February 27, 1932.) Microscopical sections revealed a multiple myeloma of the plasma-cell type. (Fig. 3.)

The question now arose as to whether multiple myeloma and hyperparathyroidism could coexist. The patient was put on a low calcium diet and revealed a negative calcium balance. This finding, associated with the osteoporosis and other findings made us still think of hyperparathyroidism. However, in view of the definite diagnosis of multiple myeloma, a course of deep Röntgen-ray therapy in dosage similar to that used by The Mayo Clinic was given without much noticeable improvement. Some weeks later, March, 1932, the patient improved, and her blood calcium at that time was somewhat lower. (See table.) Whether it was the Röntgen therapy or lowered calcium intake that caused the drop in serum calcium was not demonstrable.

After multiple myeloma was diagnosed, and deep Röntgen-ray therapy was given, the patient was returned to the care of her local physician. Shortly afterward she lost all the gain she had made and further calcium restriction did not help, neither was she in a condition suitable for further X-ray treatment. Consequently, it also was deemed inadvisable to explore the thyroid region. The patient was given symptomatic treatment but progressively grew worse until she was completely helpless, and died four and one-half months after the diagnosis of multiple myeloma was made. Necropsy (limited to neck) revealed no abnormal change of the thyroid or parathyroid glands.

DISCUSSION.—This case was very instructive since it contained findings suggestive of hyperparathyroidism. Even though some of the röntgenographical findings appeared typical for multiple myeloma, they also resembled some of the published röntgenographical findings of hyperparathyroidism and osteomalacia.[8] Again, the absence of albuminuria complicated the diagnosis. Even though its absence did not eliminate multiple myeloma, it made hyperparathyroidism seem probable.

The normal blood serum calcium value is 9.96 milligrams per 100 cubic centimetres of blood serum with a standard deviation of 0.69 milligram.[13] The presence of a high blood calcium in this case seemed indicative of hyperparathyroidism, and this view was strengthened by what seemed to be a negative calcium balance which also is a characteristic of hyperparathyroidism.

The available data concerning the blood-calcium values in multiple myeloma is very meagre while the published reports of blood-calcium values in

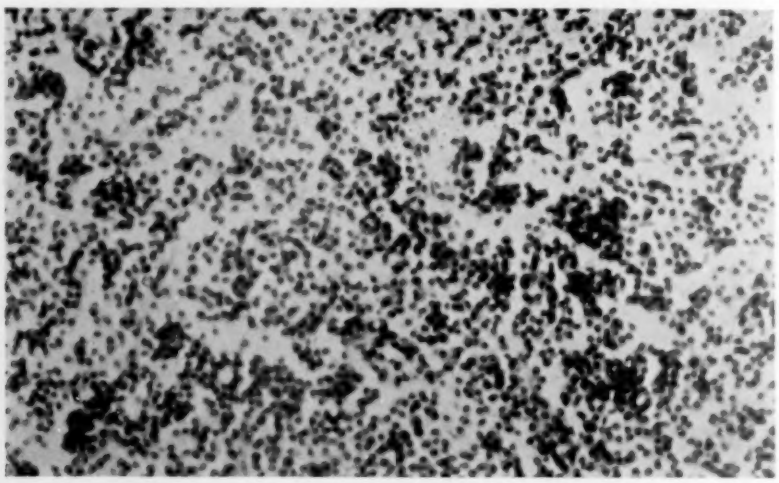

FIG. 3.—Section of tumor tissue removed from right rib. Note the numerous plasma cells with lack of stroma. (x 170.)

other malignant diseases almost invariably point to values either within or below the normal range. Clowes and Frisbe[1] found blood-calcium values very low in actively growing malignant tissue. Goldzieher[5] reported low values for serum calcium in carcinoma and other malignant tumors; while Ellice McDonald[10] said carcinoma was a disease associated with a lessened amount of total and ionized calcium in the blood. Gunther and Greenberg[6] found that about 50 per cent. of their cases had a serum calcium definitely below normal and none were above 10.5. They concluded that "the diffusible calcium is within the limits of normal variation in malignant disease." C. de Fermo[4] also found a lowered serum calcium in malignant diseases. On the other hand, Mason and Shields[9] reported a case of metastatic carcinoma which had a hypercalcæmia.

There are other diseases in which the blood calcium has been studied. Exophthalmic goitre and myelogenous leucæmias have an increased serum

calcium. Lymphatic leucæmia and myxœdema have a lowered serum calcium, while the serum calcium in allergic diseases is within the normal range.

Our consideration of hyperparathyroidism in this case paralleled that of Mason and Shields, who felt that, even though there was a possibility of metastatic carcinoma, the high blood calcium was indicative of hyperparathyroidism. However, in our case, we did not explore the parathyroid region.

In retrospect, there seems to be one vital point overlooked by Mason and Shields as well as by ourselves. In both instances there was a high blood calcium and a negative calcium balance, but the blood phosphorus consistently was normal instead of low. This finding evidently is almost as important in the diagnosis of hyperparathyroidism as is the high calcium content, since by far the greatest number of the proven cases of hyperparathyroidism had a low blood-phosphorus content.

Conclusions.—(1) Occasionally neoplastic diseases may be associated with a hypercalcæmia although, in general, hypocalcæmia is the rule.

(2) Our observation, and those of Mason and Shields suggest that when a hypercalcæmia and malignant disease, coexist, the blood serum phosphorus content is within the normal limits.

(3) From our study it would seem that the blood serum phosphorus content in hyperparathyroidism is of equal importance with the calcium content.

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ANOMALY OF THE INFERIOR LARYNGEAL NERVE

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Anomalous origin of the right subclavian artery from the descending aorta rather than from the innominate artery has been described by numerous writers. The correlative anomaly of the right inferior laryngeal nerve has also been frequently noted: in which that branch of the vagus nerve has no portion which can be designated by the term recurrent laryngeal,

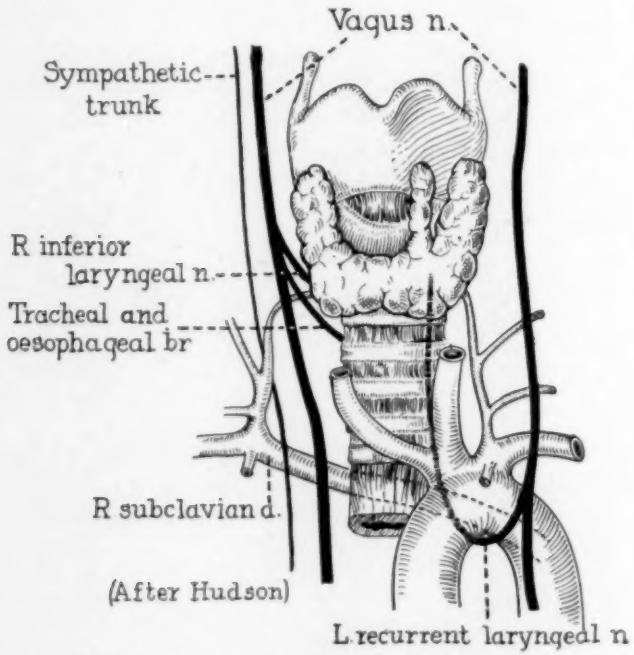

Fig. 1.—Diagrammatic drawing of a case of anomalous origin of the right subclavian artery together with absence of a right recurrent laryngeal nerve. The right inferior laryngeal nerve proceeds directly from the vagus to its distribution. (After Hudson, 1921.)

because it does not recur around the anomalous subclavian artery. It is the purpose of this article to point out the incidence of these related anomalies and to call attention to their possible clinical significance.

The literature on both anomalies was exhaustively reviewed by Holzapfel[2] (1899). His earliest reference to the anomaly of the right recurrent laryngeal nerve is the report of Stedman[5] (1823). Holzapfel found that of thirty-five descriptions of the arterial anomaly, three showed the nerve as looping around the anomalous artery; four others exhibited recurrence of the nerve around the right vertebral artery, which in these cases was a

branch of the right common carotid; the remaining twenty-eight reports (and all others found by the writer in the more recent literature) describe the nerve as originating from the vagus at the laryngeal level and passing directly medially behind the common carotid artery to the larynx.

In surgery of the neck, and especially of the thyroid gland, the inferior laryngeal nerve is sometimes accidentally injured. If the nerve is not in its expected position, it is more than ordinarily liable to injury. Fig. 1 is a diagrammatic representation of the associated anomalies here described. It was drawn from a museum specimen of a case discovered in this laboratory and described by Hudson,[3] in 1921. The nerve of the left side shows the normal relations for that side, but the right inferior laryngeal nerve is seen to leave the vagus near the level of the cricoid cartilage and to turn directly medially in close relation to the inferior thyroid artery at its medial bend.

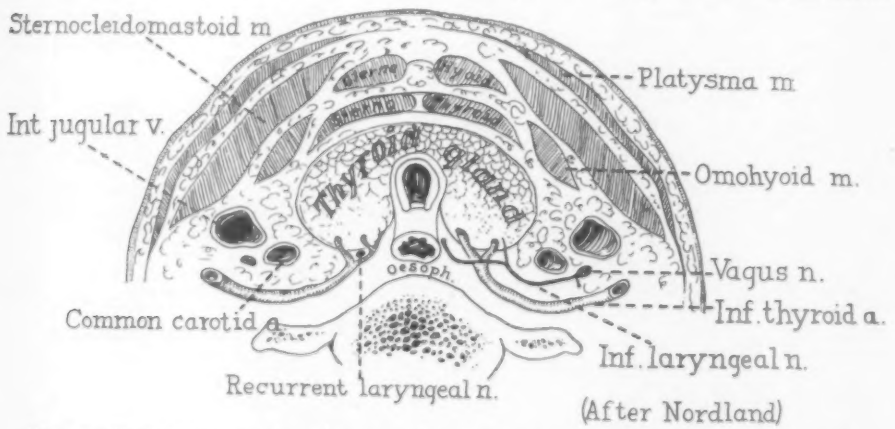

FIG. 2.—Diagrammatic drawing of cross-section of the neck in Hudson's (1921) case of absence of a right recurrent laryngeal nerve. The right inferior laryngeal nerve originates from the vagus at the level of the section and accompanies the inferior thyroid artery to the posterior portion of the thyroid gland on its way to the larynx. (Adapted from Nordland, 1930.)

The possibility of injury to the nerve in its exposed and unexpected position and in its unusual relation to other structures is obvious. The contrast between the normal and abnormal relations of the nerve may also easily be seen in Fig. 2, a cross-section drawing adapted from Nordland[4] (1931).

The writer[6] and others (1932) examined 159 aortic arches (seventy-two of white males, fifty-six of Negro males, twenty-three of Negro females, and eight of white females) and found four anomalous right subclavian origins. One case occurred in each of the four race-sex groups. The percentage incidence of the arterial anomaly in the author's total series is therefore 2.6 per cent. Other authors (quoted from Adachi,[1] 1928) have reported percentage incidence as follows: Quain, 0.4; Turner, 0.4; Leboucq, 0.5; Holzapfel, 0.6; Stieda, 0.8; Tiedemann, 0.8 Thomson, 1.0; Hyrtl, 2.0; Adachi (for Japanese), 0.2. Adachi suggests that the anomaly of the right subclavian artery is commoner in Negroes than in other races, and quotes several examples in Negro females. The incidence for the author's white males is 1.4 per cent.; for Negro males, 1.8 per cent.; for Negro females,

1 in 23, or 4.3 per cent.; for white females, 1 in 8. One is hardly justified in stressing percentage incidence in such small series as the two latter.

The point of this article is not to define the exact incidence of these associated anomalies. It is rather more important to suggest that the surgeon may encounter one or more of these cases in every series of 100 thyroid operations that he performs. It is also possible that the presence of these anomalies may account, at least in part, for unexplained post-operative symptoms of injury to the inferior laryngeal nerve.

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AMOUNT OF GLAND TO BE LEFT AT THYROIDECTOMY

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The two questions most frequently asked: "What causes a goitre?" and "If the goitre is removed, will it come back?" can be answered rather vaguely in the first instance, but satisfactorily enough in the second instance. The two questions, however, are linked together, for the known circumstances under which goitre occurs, if allowed to persist, may bring about a recurrence regardless of how little gland is left behind at operation. Though

Fig. 1.—The head is turned to the right side, bringing out the configuration of the sternomastoid muscle. A line from the tip of the mastoid process to the mid-point of the clavicle bounds the posterior border of this muscle and the mid-point of this line or a line intersecting with it from the upper border of the thyroid cartilage is opposite the transverse process of the four cervical vertebra. The needle point is pushed in to the bone, from right to left with an inclination backward and ten cubic centimetres of novocaine 1 per cent. are injected as the needle is slowly withdrawn.

the cause of goitre is not known, certain circumstances under which it occurs are definitely recognized and a more satisfactory statement can be given than a dictionary definition, as: "Goitre is a disease of unknown cause, the most common characteristics of which are disturbed function and enlargement of the thyroid gland."

In a series of over 2,500 thyroidectomies, (1) 2,238 were women and women frequently with a hypo-ovaria; (2) there was a shortage on iodine, as proven by the benefit of administering iodine in a large number of the

1,482 cases of exophthalmic goitre and in some of the 1,018 cases of adenomata, simple goitre and thyroiditis; (3) there was a focus of infection suggested by the improvement in the thyrotoxæmia by the removal of a definite focus and the hyperplasia actually accompanying a thyroiditis; (4) there was a relation with other endocrine glands, particularly the adrenal, as suggested by usually high systolic and pulse pressures and the exaggeration of symptoms on giving epinephrine; with the pancreas, suggested by the disturbed carbohydrate metabolism; (5) there was a thyro-thymic-lymphatic constitution, the familial tendency in exophthalmic goitre and the proneness to recurrences; (6) there was mental and physical overload, the larger proportion of men during the war and during this depression.

FIG. 2.—The second point of injection is made about an inch below the tip of the mastoid process, on the level of the angle of the mandible and the posterior border of the sternomastoid muscle. This point is about opposite the transverse process of the second or third cervical vertebra.

There are many contributions and a revival of these contributions recently on the subject of how much of the thyroid gland should be removed. (Pemberton, McClure, Lahey.) The question of importance is not how much goitrous gland can be sacrificed, but how much should be spared, or what minimum amount of gland left behind can eventually and permanently stabilize the thyrotoxic patient and sustain, as near as normal, a satisfactory metabolism.

Certainly and without argument, the more of the thyrotoxic gland removed or the less left behind, the more immediate and permanent relief of the thyrotoxæmia. On the other hand, some gland, though a minimum amount, must be left behind in the presence of the most intense thyro-

toxæmia to surely protect the parathyroids glandules and recurrent laryngeal nerves and forestall a hypothyroidism. At the first operation a sufficient amount of gland must be removed, not only to surely reduce the thyrotoxæmia, but to protect, so far as possible, against a second or third operation. Theoretically, at least, every operation offers still further chances of injury to the parathyroids and recurrent laryngeal nerves; forty-seven of our total series had been operated on elsewhere and were reoperated on by us on account of persistent or recurrent thyrotoxæmia, and thirteen of our own cases were subjected to sixteen second and third operations and demanded these operations as much at the second and third times as at the time of the original operation.

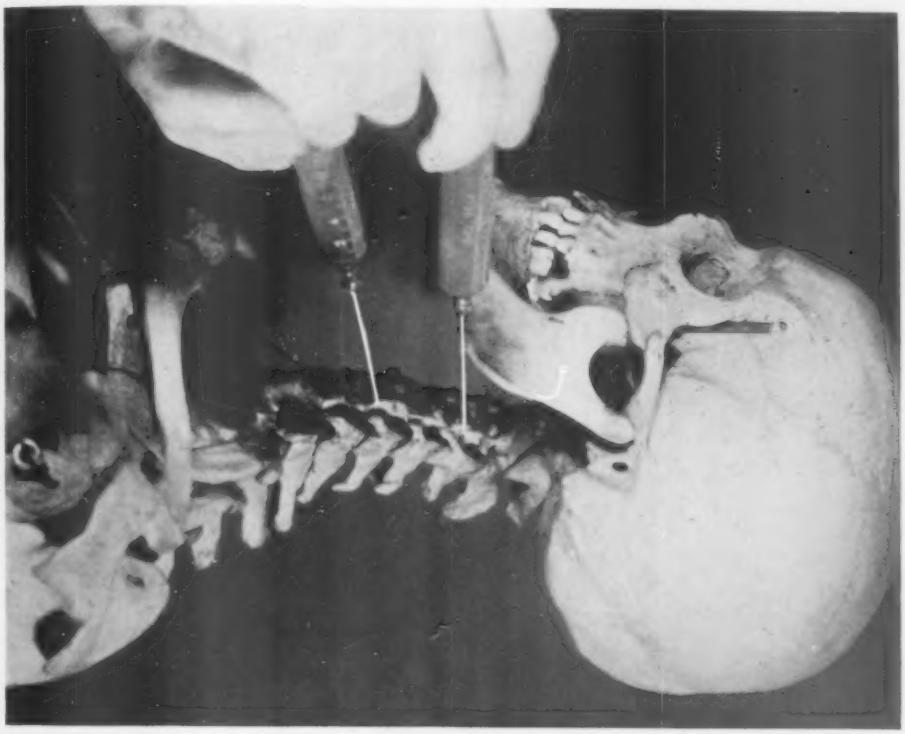

FIG. 3.—The top needle inserted an inch below the tip of the mastoid and on the level of the angle of the jaw, reaches the bony resistance near the transverse process of the second and third and the lower needle near the fourth and fifth transverse process of the cervical vertebra. One injection of ten cubic centimetres at this point on each side, without any further infiltration, has sufficed for a perfect anæsthesia.

One patient operated on three times still has a metabolic rate of plus. 24. A larger amount of tissue should be left behind in all cases of thyroiditis accompanied by thyrotoxæmia, because the final result of the inflammatory process is the destruction of the gland and a hypothyroidism. The reasons that thyroiditis is operated on at all are: (1) To drain an abscess or to liberate the adherent and hardened condition of the gland itself and the structures in the neck, as for example, following a cellulitis and in Riedl struma and Graham's struma lymphomatosa—the resection of the isthmus, as

well, in the relief of Riedl struma may not only relieve the hampered trachea but the whole liberation may improve the blood supply of the gland itself from the surrounding tissue; (2) To lessen thyrotoxæmia, particularly in the diffuse tuberculous type, accompanied by thyrotoxæmia; (3) On account of wrong diagnosis the Riedl struma is operated on for carcinoma, or the thyroid gland found diffused with tubercules, and accompanied by hypertrophic and hyperplastic cells.

The amount of goitrous gland removed is not to be judged by bulk, for there are cases improved in the way of increased secretion by the removal of bulky non-toxic adenomata which have crowded out the secreting portion of the gland, crowding even the parathyroids.

Pemberton[1] is quite right in two of his statements: "The high proportion of patients who are entirely and permanently relieved of their symptoms by subtotal thyroidectomy, in which a varying amount of thyroid tissue is left, is sufficient clinical evidence to indi-

FIG. 4.

FIG. 5.

FIG. 4.—The lateral points are connected with injections under the skin along the line of the projected collar incision, while waiting for the nerves of the cervical plexus to "take up" the novocaine.
FIG. 5.—Outline of the sternomastoid muscle and the short collar incision, c—c. The additional length of incision B—c is not needed. a and B are the horizontal levels at which injections are made.

cate that the remaining portion of the gland regains its power of regulating its function to meet varying demands," and, "as long as there is any viable thyroid tissue, even though (temporarily) functionally inadequate, to meet the normal demands of the body, it is capable, under proper stimulus, of regenerating even to the point of causing hyperthyroidism." He cites two cases of myxœdema, following thyroidectomy, where marked thyrotoxæmia recurred and one of the cases required a second operation. When the factors or circumstances under which thyrotoxæmia has originally developed are allowed to persist, any case may recur more than once. The most difficult factors to combat are the unalterable hereditary disposition, particularly in the woman with a hypo-ovaria, born predisposed and ever inclined to a recurrence.

I heard Pemberton,[2] in a recent paper, state that his proportion of women to men was 2:1 instead of 10:1, as reported in my series. During the war and now during the depression, my rate of men to women has risen markedly, now about 5:1 women to men. During these years of financial depression, when men driven into frenzy by disruption of their business, money losses and extreme despair, when many have committed suicide, gotten drunk for liberation and have stirred the gland of emotions, the thyroid, to over activity, the exophthalmic goitre group of men has increased. I saw just such conditions

among the men with thyro-toxic tendency during the war: effort syndrome, shell shock, thyro-toxemia. The postponement of operation has offered cases far more severe burnt out from delay and the mortality consequently increased during the last two years, due to these factors, and in addition, a more precipitous attitude in selecting these cases, influenced, perhaps, by a too ardent desire to put these people back on their feet rapidly and likewise the very human ambition to maintain the number of cases operated on. During this last two years, out of 303 cases, 41 were men, nearly double my former figures. There were also four recurrences.

I have seen people, not of the hyperthyroid tendency, but frenzied by their reversed conditions of living, along with the abrupt changes in "morals and manners," get a certain amount of beneficial liberation from themselves by the use of alcohol, but this liberation would be temporary in effect and produce a next day's weariness and fatigue, almost equal to pain, when called upon to do any exacting piece of work.

The hyperthyroid person suffers a severe "hang-over" from even so-called moderate drinking, an effect far beyond the usual weariness and fatigue, to the point of "Jitters."

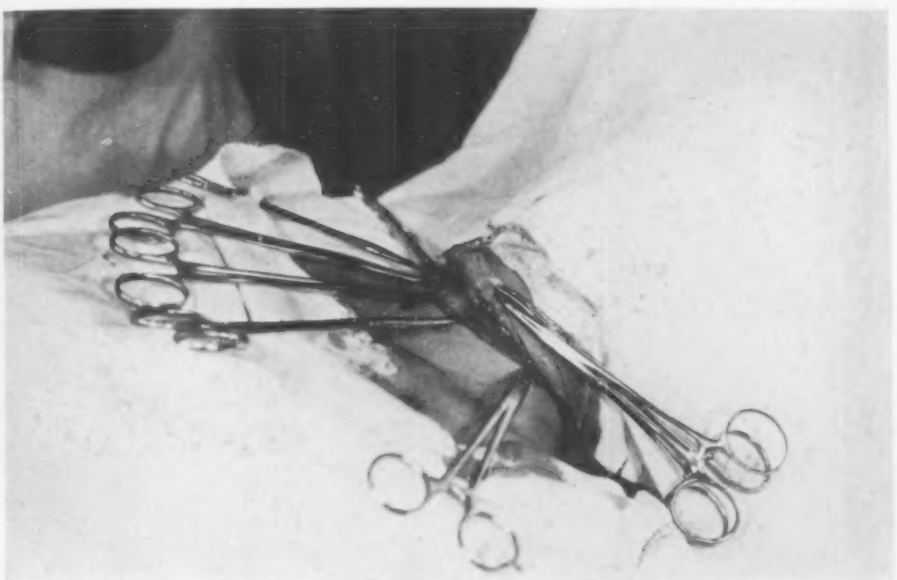

FIG. 6.—Incision down through skin, fat and platysma muscle, fascia of sternohyoid and sternomastoid muscles exposed.

The effects of alcoholism and thyro-toxemia, to the stage of delirium, are in many ways similar.

The standard operation of bilateral resection at The Mayo Clinic embraces the removal of the isthmus, a part of both lobes, preserving on each side of the trachea an amount of gland equivalent to from one-sixth to two-thirds of the amount of tissue in a lobe of normal size. Of 1,683 patients with exophthalmic goitre, fifty (2.9 per cent.) demanded further surgical treatment. Pemberton[3] did not state the proportion of post-operative hyperthyroidism to hypothyroidism.

Out of a total group of 1,270 goitre operations, McClure[8] reported forty (3.2 per cent.) cases with post-operative hypothyroidism and fifteen cases (1.2 per cent.) of post-operative hyperthyroidism. He does not state the original number with thyro-toxæmia of the Graves' type. His post-operative results were 3 to 1, hypothyroidism over hyperthyroidism. His operation is more radical than the standardized operation at The Mayo Clinic.

Lahey[4] does not give figures and proportions of number of post-operative hyper-

thyroidism to hypothyroidism, but indirectly, with the exception of children in the pre-adolescent and adolescent period, elderly patients, marked involution after iodine administration and multiple adenomata, all of which are embraced in our statement that the amount of tissue left behind is to be judged more by the pre-operative thyrotoxæmia and metabolic rate, rather than the bulk of the gland, we have included these exceptions in our general statement. On the other hand, in the same types of cases we are speaking about, those with intense thyrotoxæmia, he does about the same radical operations as we do. Quoting Lahey: "Complete removal of the thyroid isthmus, with premeditative baring of the trachea and this baring of the trachea does not produce any disturbing amount of post-operative tracheitis, and with extensive removal of thyroid tissue from the lateral lobes of the thyroid leaves a safe amount of tissue over the recurrent laryngeal nerves and the parathyroid bodies and makes possible the radical removal of the thyroid tissue that is often necessary to bring about lasting cures in hyperthyroidism."

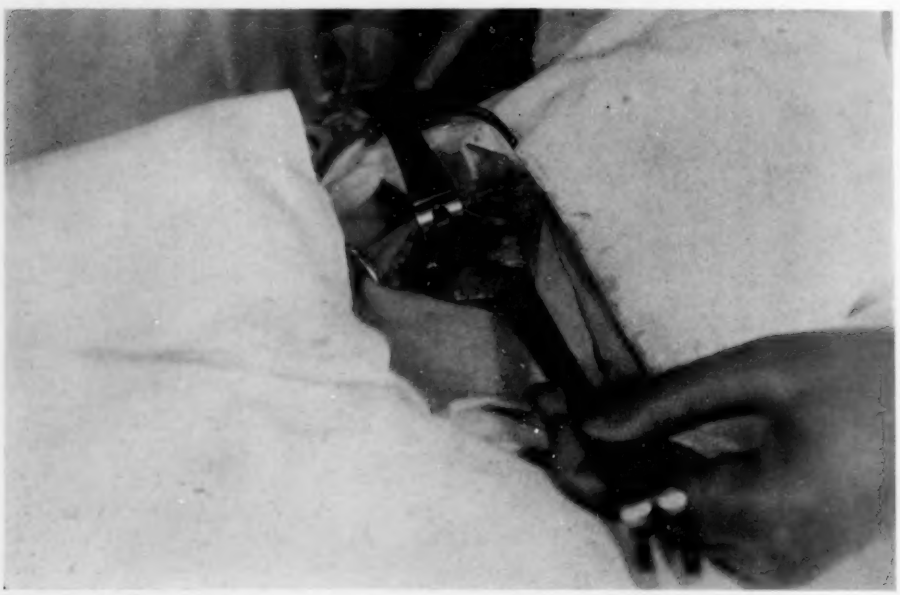

FIG. 7.—Transverse incision retracted vertically. Incision vertically between sternohyoid and sternothyroid muscles, separation between deep cervical fascia, false capsule, and thyroid gland, true capsule. Muscles well relaxed, widely retracted, gland exposed.

Greene[6] has operated on twenty-six children between eight and sixteen years out of a series of 1,200 thyroidectomies. He thinks little of the precaution of preliminary ligation or chances of hypothyroidism during the growing period except more gland should be left behind. Still, he had two recurrences out of twenty-six cases.

Coller and Arn[8] conclude: "A large part of a nodular goitre can be removed from a patient with a basal metabolic rate in the low limits of normal without importantly affecting the rate."

The large majority of this series of 2,500 thyroidectomies was done on account of the thyrotoxic state. Lobectomies or sub-total thyroidectomy in 1,482 cases of exophthalmic goitre; enucleations, unilateral and bilateral resections and dissection in 1,018 adenomata, cysts, simple goitre and thyroiditis.

Females predominated in the proportion of 2,238 to 262 males; ten children, all females.

Death occurred in twelve cases, ten of exophthalmic goitre and two of adenomata. There were three late deaths in cases of recurrent carcinoma, which has made up about 1 per cent. of the group of 1,018 cases.

There were forty-seven cases operated on elsewhere in the whole series of 2,500, requiring a second operation by us. Of the 2,500 cases operated on by us, thirteen cases, ten of exophthalmic goitre and three of adenomata, have required reoperation, and three of these were reoperated on twice on account of hyperthyroidism. The metabolic rate in all of these cases was above plus 30.

We have found but three cases of permanent hypothyroidism following all operations for exophthalmic goitre and toxic adenomata and certainly

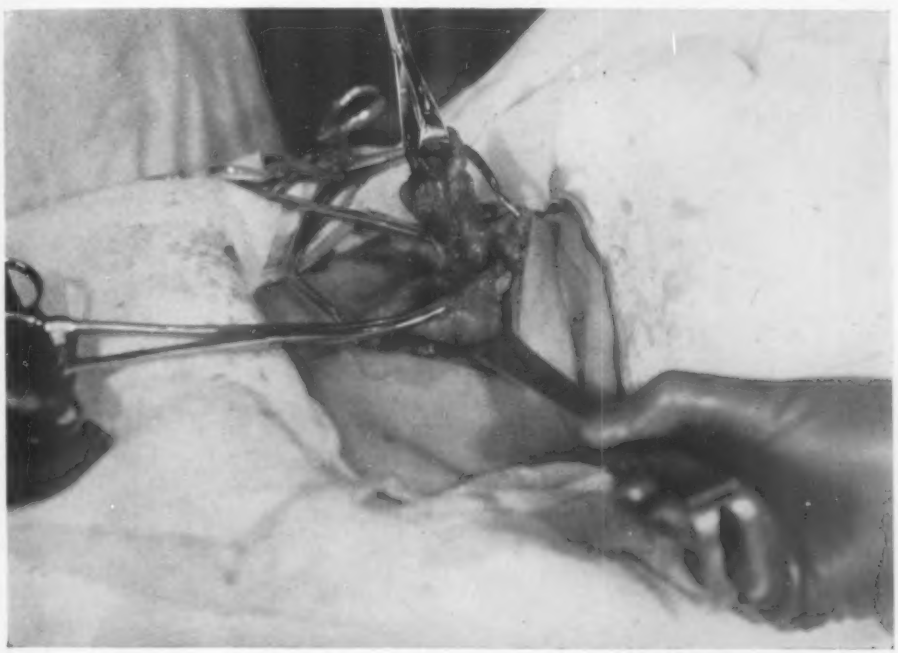

FIG. 8.—Isthmus bluntly elevated from trachea, split or resected, right lobe undercut from trachea and held up with lobe clamp. Left lobe held with curved clamp.

no case of myxœdema. There have been, however, a number of cases of transitory hypothyroidism which have finally stabilized by withdrawal of post-operative iodine administration or the taking of thyroid extract over a short period of time. There has been one death from severe and persistent hypoparathyroidism and tetany, and three cases who showed mild transitory symptoms of hypoparathyroidism, and, strange to say, the case of tetany and death was an adenoma where it would hardly seem possible to have disturbed the parathyroids. There were no voice changes but a typical accoucheur's hand contraction on the table. There is no case of permanent aphonia. There are, however, four cases with altered voices and lameness or paralysis of one vocal cord.

In the thirteen cases where second or third operations were done and

three operated on twice, making sixteen second or third operations on thirteen cases, all but one has returned to a satisfactory state of thyroid stabilization, judged by clinical symptoms and metabolic rate. There is no evidence of hypothyroidism, nor hypoparathyroidism, nor alteration of voice after these second and third thyroidectomies. The one case after three thyroidectomies is still mildly hyperthyroid with a metabolic rate of plus 24, but his clinical improvement is satisfactory.

Our operation in cases of exophthalmic goitre for the last fifteen years has been almost invariably as follows: Usual collar-line incision but very short incision, dissection of flaps between platysma and underlying muscles or between fat and platysma,

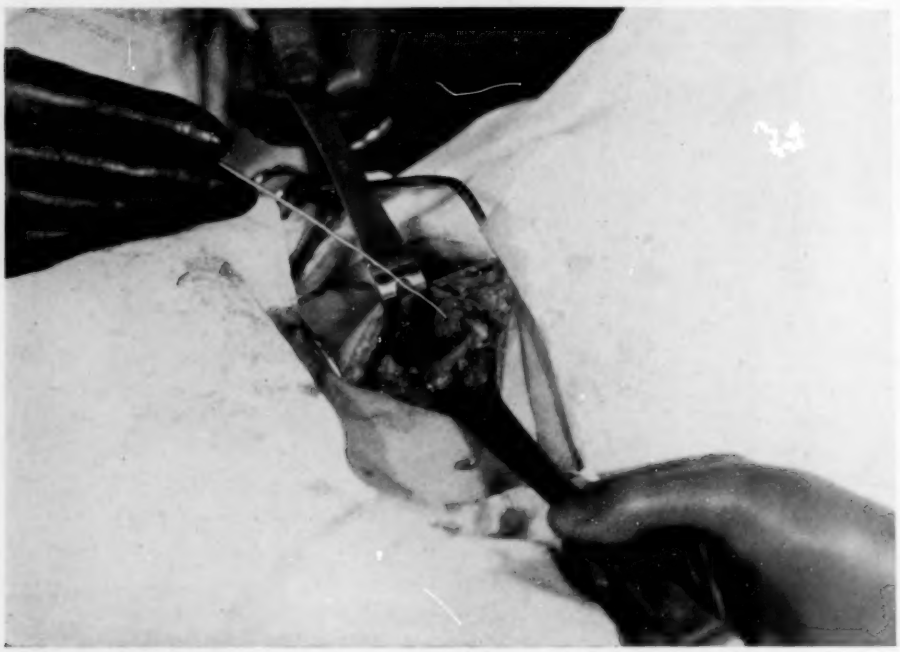

FIG. 9.—Both lobes undercut and resected leaving strip of thyroid on each side of bared tracheal fascia. Probe touching small portion of right lobe left behind at upper pole before allowing it to sink into depth of neck.

incision up and down between muscles, rarely with transverse cutting, gland exposed. Our dissection is not very wide, only enough to make the gland accessible. The isthmus is bluntly elevated from the trachea, when possible caught with two clamps and cut, leaving the fascia covering the trachea. The two lobes are immediately begun to be undercut, leaving a thin wedge of gland on either side of the trachea. Then working from the lower pole upward, each lobe is raised from its capsule, the superior vessels easily recognized and by still undercutting and elevating, all gland is removed except the wedge-shaped strips along the trachea and continuing into the upper pole, about one-quarter to one-half inch broad and thick. Special attention is paid to the vessels at the lower border of the gland, to those springing from the trachea and the ramifications of the inferior thyroid, clamped separately, close on the gland, on account of the blood supply to the parathyroids. It is remarkable how easily the lateral lobes are raised out of the neck, when the attachments to the trachea are cut and the vessels in the true capsule, all around the periphery, are clamped high on the gland. The operation amounts to an enucleation of almost the whole lateral lobes, each a cone with the small end at the

superior pole. We are forced at times to "take off" at the side of a bulky isthmus or first to resect the isthmus on account of its bulkiness, or, occasionally, to pull the upper pole down. The amount of gland left behind varies from the extreme of a wedge one-quarter to one-half inch wide and thick, depending upon the toxic condition of the patient before operation as judged by the circulation, excretion, nutrition, self-control, basal metabolism and perhaps some such test of breath-holding or general stamina as done by Willard Bartlett.

Not only can an estimate of the general condition of the patient be made during pre-operative preparation, but frequently a difference in the size and texture of the gland itself can be made out as involution takes places. The more readily involution takes place in the gland under preparation with iodine, the softer elastic the gland becomes, though perhaps larger. This change in the gland itself can be recognized at operation by the naked eye. The original hard, granular, friable, very vascular reddish-brown gland has become more pinkish, more glassy and less friable. If involution takes place readily under iodine it is desirable that more of this gland, as well as all glands of the colloidal type, be left behind.

As pointed out by Lahey, it is particularly desirable that sufficient gland be present to meet the demands of adolescence and the abating cellular activity of old age. On the other hand, only a very small amount of the uninvoluted gland, at whatever age, must be left behind to assure stabilization in thyrosusceptible patients. We consider our operations radical in cases which are or have been markedly thyrotoxic, radical for the sure relief of the thyrotoxæmia and the forestalling of reoperation, but of course to no such point of stripping the trachea as done by Richter in Chicago, with his claim that he leaves "just a gram on each side of the trachea." We cannot even visualize just a gram of thyroid gland in the neck.

At the second or third operation, the wedge-shaped strip and portion of the upper pole have been found much enlarged on one or the other, or on both sides, the size of the gland at many primary operations. After separation of the sterno-thyroid muscles from the front of the trachea and gland, mostly by sharp dissection, the lobes are again undercut from the mid-line outward and elevated from the lower pole upward and outward to the upper pole, with difficulty on account of adhesions, but in the same way as at the primary operation. We have but one case of post-operative hyperthyroidism and no other particular disturbance in the post-operative course of these thirteen reoperated-on cases, in spite of the fact that metabolic rates ranged from plus 30 to 65.

At all operations for adenomata, we have inspected, palpated and even incised every portion of the gland left behind for additional smaller adenomata, and, in spite of this diligent search, have had three cases of growth of an adenoma evidently left behind, while in process of growth from a small focus. On one of these we operated three times, at each time removing additional adenomata. This was not carcinoma as we first feared, and proved not to be by pathological section and confirmed by the fact that the man is living and in good health eight years since the last operation. These

cases of adenomata were not reoperated on because of recurrent masses in the neck, but on account of elevation of metabolic rates from plus 30.

It is made clear from the above report and description of operation that the number of cases of both recurrent hyperthyroidism and hypothyroidism have been comparatively few, that the chances of hyperthyroidism are about four to one over hypothyroidism, in spite of the fact that the operation is radical, leaving a minimum quantity of the gland behind. This procedure at first, second and third operation has been safe and has given almost absolute protection to the recurrent laryngeal nerves and parathyroids.

The wedge of gland left along each side of the trachea, by immediately undercutting the lobe and entirely detaching it from the wedge, prevents the necessity of pulling on this important area overlying and protecting the parathyroid glandules and recurrent laryngeal nerves. We have found our own sixteen cases of second and third lobectomies easier to approach than the forty-seven cases requiring a second operation, which were originally operated on elsewhere. In these latter patients, we have found an extreme bulkiness and scarring over the trachea and a large amount of gland particularly in the region of the upper poles. We have found the pad of gland between the trachea and overlying muscles more adherent to muscles than to the bared tracheal fascia and much more bloody in liberating from the muscles. Our closures unite the sternothyroid and sternohyoid muscles separately.

Most of our thyroidectomies drain from twelve to sixteen days, after the removal of small drain tubes in forty-eight hours, and a small skin incision is kept open by the insertion of a probe. We hear little mention of this rather prolonged drainage from other sources in the literature, though the operators tell me about the same experience. Some of the remaining gland is lost through prolonged drainage, particularly when large portions have been ligated or the tissue sewn together in bulk, or when an infection is superimposed.

The least of our trouble has been secondary hæmorrhage, although we not infrequently find considerable blood on our first dressing, in spite of what has appeared to be complete hemostasis at the end of the operation. Where there is apparently a small hematoma, we think it better to let it disorganize and gradually drain away, which it invariably does, rather than re-enter the neck to remove it.

We have been very careful about operating on children and have tried a preliminary ligation in one case followed later by thyroidectomy. Our experience leads us to believe that there is very little to be gained by ligations at any age and that intense thyrotoxæmia must be reduced even in children.

In the preparation of patients for operation, we have observed that the refractoriness to iodine may disappear after a considerable period of freedom from it and that iodine can be given again with benefit. This observation has been particularly true in those of the Graves' type of thyrotoxæmia

which have recurred a year or more after the primary operation. We have been able to smother an occasional toxic crisis, usually post-operative, by the giving, in desperation, of a large quantity of iodine intravenously, and feel that this benefit has been brought about by the qualitative alteration of the thyroid secretion in the blood-stream.

We do not believe that the condition of the patient can be determined by the metabolic rate alone, but rather by the general improvement. Some of our patients, with rather low rates, have reacted violently, whereas those with very high rates, which have been but little reduced under preparation, have shown no reaction after operation. There is evidently a susceptibility of certain patients to thyroid-secretion just as to caffeine and alcohol.

We have had little benefit in treating adenomata with iodine and have usually seen a non-toxic adenoma aroused to activity by the administration of iodine, except in children, with adenomata present at birth or appearing early in childhood. These adenomata in children, though reduced in size and softened by iodine, never disappear. Even in the soft, diffuse, non-toxic goitres of adolescence, iodine has not brought about a reduction in the size of these glands overnight. At least three of these patients have been driven into a thyrotoxæmia of the Graves' type by an excessive and prolonged use of iodine. The diffuse, non-toxic goitre of the colloid variety, possibly embracing adenomatous inclusions in 20 per cent. of cases, occasionally shows the effect on the adenomatous inclusions by an aroused toxicity in the presence of iodine. We have seen adenomata appear in these glands as the surrounding hypertrophied tissue became less bulky.

We think the final thyroid cell, lining the acinus, whether originally appearing in a fœtal or adult adenoma, in the diffuse goitre with or without toxæmia, is one and the same cell altered merely in hyperplastic activity and giving rise to a secretion varying in quantity rather than quality.

The thyroid cell, embraced in the capsule of an adenoma of long standing, is far more apt to break its cohesion with other cells and become prolific and mitotic than the cell free in the whole lobe. About 90 per cent. of carcinoma of the thyroid, amounting to about 2 per cent. of all adenomata, occurs in long-standing adenomata. I have never seen but one diffuse carcinoma of a lobe of the thyroid where there was not evidence of a pre-existing encapsulated adenoma. Since an early adeno-carcinoma can be diagnosed only by the piling up of mitotic cells, which have invaded a blood-vessel, the taking on of any acceleration of growth of an existing adenoma should be a warning to operate and remove the adenoma, not by simple enucleation, but by resection or lobectomy, that is, the adenoma with thyroid tissue surrounding it. Adenomata in patients under thirty may be regarded with more complacency and the operation determined on account of the accompanying toxæmia, rather than malignancy. Our experience with adenomata and the age of appearance leads us to believe that they are far more frequent in the young, that is, before thirty years, than a review of the literature would lead one to believe.

Our observations of our own cases in regard to the thyrotoxic state following thyroidectomies has been that of persistent or recurrent hyperthyroidism, 4 to 1, over hypothyroidism, whereas McClure, who does about the same radical operation as we do, cites an incidence of hypothyroidism, 3 to 1, over hyperthyroidism. Pemberton, who does a standardized operation, less radical than McClure[3] and I, has had about three times as many recurrences of hyperthyroidism. I judge Lahey's operation as to amount of gland left behind in severely toxic cases of the Graves' type is about the same as that of McClure and me. Pemberton is quite right, however, in his observation that the percentage of recurrence of hyperthyroidism is not to be determined alone by the quantity of gland left behind, and, in proof of his contention, cites three cases of marked hypothyroidism, which eventually again become hyperthyroid.

The same circumstances or factors, namely, a woman, usually with hypo-ovaria, a focus of infection, shortage on iodine, a mental and physical drive, all continuing to play on the predisposed type of individual, may bring about a proliferative hyperplasia and an accompanying thyrotoxæmia, even when a minimum of thyroid cells have been left behind at the original operation. These patients must receive preferably printed instructions as to rest and care of themselves and encouraged to return regularly for observation and advice.

I shall not dwell upon the dual phases of thyrotoxæmia, hyperthyroidism and hyperadrenalism. I shall leave the discussion of the interrelation of the secretions of these two glands entirely to Crile,[7] until I am aroused to change my tactics on account of less favorable results by operations on the thyroid gland alone. I must admit, on the other hand, a combined hyperadrenalism, after observing the effect of epinephrine on hyperthyroid patients, as well as the usual high systolic and pulse-pressure type of patient with higher metabolic rate and particularly the gastro-intestinal type with vomiting and diarrhœa. I once thought that epinephrine should actually be administered to the exhausted, emaciated type of patient with low blood-pressure, on the assumption of a depleted adrenal gland, particularly since some of these low blood-pressured, even-pigmented patients suggest a combined picture of hyperthyroidism and hypo-adrenalism, Addison's disease, but even these patients are driven to further exhaustion and are acutely aroused by epinephrine.

The scope of this paper and the time limit will allow but a few remarks on the relation of the thyroid and pancreas. I have found an increased blood sugar in hyperthyroid cases, both before and immediately following operation. I have been able to arouse the patient from a somnolent or comatose state by giving insulin or glucose and insulin and have finally seen the blood sugar remain at a normal level. We may certainly feel better fortified in our position before operation by having paid some attention to a blood sugar and blood calcium, as well as to the condition of heart muscle and fibrillation and the function of the vocal cords.

CONCLUSIONS.—(1) Thyrotoxæmia in our series of cases occurs overwhelmingly in the women. The number of men increased during the war and now during the depression. The association is probably a hypo-ovaria. At puberty, menstruation, the menopause and during pregnancy, the thyroid works inversely parallel with the corpus luteum. When the corpus luteum is adequate, there is little or no enlargement of the normal thyroid gland.

(2) Certain factors, namely, the woman, a focus of infection, demand for iodine, seasonal and dietetic effects, mental and physical strain, and a goitre constitution must be considered. Thyroiditis makes up ½ per cent. of operative material and ¼ per cent. of all observed clinical cases. Thyrotoxæmia may accompany most types of thyroiditis at any stage, usually the acute or subacute stages.

(3) Iodine is slow in flattening even simple, diffuse, non-toxic goitres of adolescence. Its prolonged and excessive use may bring about a thyrotoxæmia even in these cases. It may arouse a non-toxic adenoma to a fierce activity. It is of marked benefit in thyrotoxæmia of the Graves' type and refractoriness to iodine may be overcome by a period of freedom from iodine.

(4) The prevention of recurrence of proliferation of thyroid tissue and thyrotoxæmia cannot be accomplished by the post-operative administration of iodine, nor by the radical removal of the gland alone, in the presence and persistence of the above factors influencing and exciting thyroid activity. In cases with persistent autonomic symptoms likely related to the "brain" of the autonomic and chromaffin systems, the adrenal gland, a denervation of the adrenals in Crile's hands has stabilized these patients.

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SKIN CONSERVATION IN RADICAL MASTECTOMY FOR CARCINOMA

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It has been the custom in radical mastectomy to sacrifice the skin covering the entire breast, leaving in many instances a wide gaping wound often difficult to close. This procedure has been followed more from traditional proscribed teaching and habit than from any reasonable justification. There certainly is no rational reason why the integument covering the side of the breast not containing the tumor mass should be sacrificed. Sections made of the skin and areolar tissue covering the breast outside of the tumor area show no histological changes from the normal. In fact, sections made of the skin and areolar tissue right above the mass when the skin is not adherent show no changes from the normal.

When the skin is yielding and elastic, the wound closure is easy, but in many cases there is great tension, immobilizing that half of the chest, making the patient very uncomfortable, or considerable surface must be left uncovered, which either has to be allowed to granulate or be skin grafted. In many instances, where a large area of skin has been removed, the tension, when wound closure is attempted, is so great that the blood supply of the integument is interfered with, resulting in necrosis, and the scar following healing is ugly, irregular, and has a tendency to spread. Skin recurrence is infrequent and is more likely to occur in scar tissue or skin which has been under tension, and is adherent to the chest-wall. Handley pointed out that Halsted, who laid special stress on wide skin excision, had 16 per cent. of recurrence in the skin, while Cheyne, who removed more fascia than Halsted but less skin, had only 6.5 per cent. of such recurrence.

An ideal breast incision should permit easy access to the axillary space so that thorough removal of axillary lymph-nodes and fat can be accomplished. It should permit closure of wound without undue tension, without the necessity of skin grafting or a granulating area, and should leave a fairly presentable linear scar.

Each of the classical incisions so far devised was to be the ideal one, with the thought in mind that it would cover the wide gaping wound completely without undue tension. All of them, in many instances, failed, only because of the unnecessary sacrifice of normal skin covering the normal part of the breast.

Various methods of skin plastic, flap formation and wide skin undercutting and mobilization are necessary and resorted to in order to enable wound closure, and even then with considerable tension and difficulty.

All this can be avoided by conserving and ûtilizing the skin covering the

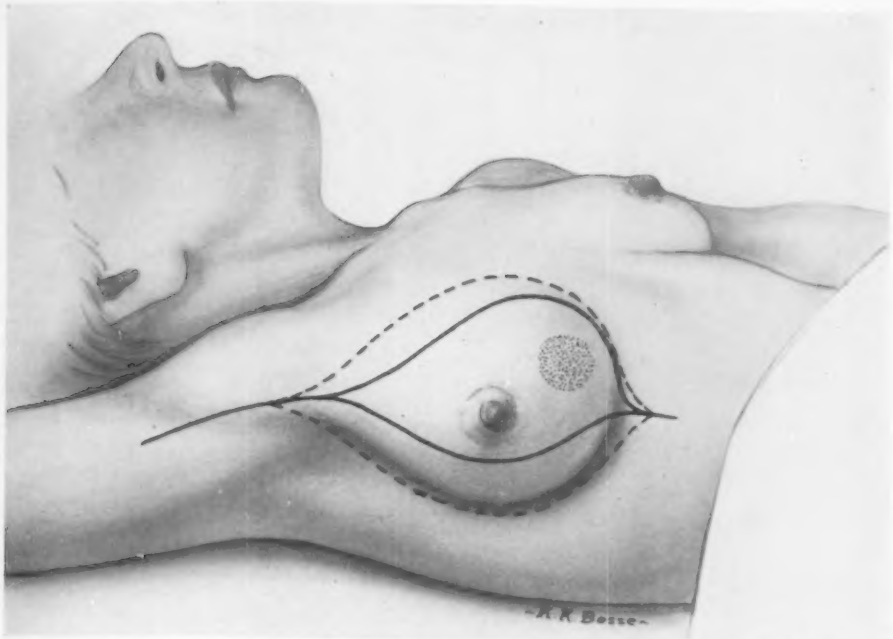

FIG. 1.—Radical breast amputation showing outline of conservative skin incision (black line), with approximate amount of skin saved. Dotted line showing usual incision sacrificing skin covering entire breast. Tumor in left lower quadrant.

FIG. 2.—Radical breast amputation showing reflected amount of conserved skin dissected off the normal side of the breast, giving free access to axillary space and pectoralis major. Tumor in left lower quadrant.

breast farthest away from the tumor in the breast, depending upon its size and location. (Figs. 1 and 2.) Dividing the breast into quadrants, since tumors can be so classified, the skin is to be conserved by dissecting it off the side of the breast not containing the mass, thereby the amount of integument gained will be from two to three inches in width, extending the entire half diameter of the breast, and the closure of the wound, therefore, will be much more easily obtained with the least degree of tension. In many instances, the outline of the skin incision can be carried up to the areola of the nipple. It should never include the nipple or its areola, particularly when there is nipple retraction.

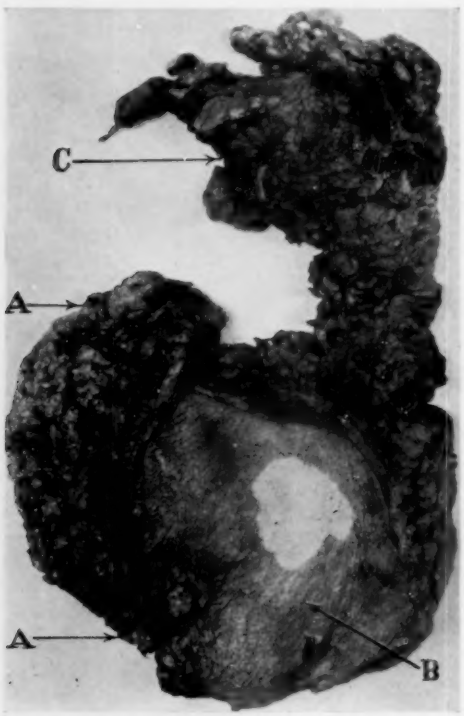

FIG. 3.—Mrs. A. K., aged forty. Carcinoma left breast. A-A—Normal side of breast. Conserved skin dissected off breast about 2½ inches up to areola margin. B—Site of tumor. C—Axillary contents.

This partial subdermal amputation of the breast is bound to give the patient greater comfort, because the conserved integument covering the chestwall will be free, pliable, and non-adherent. Much greater flexibility of motion of the arm will be present very early after wound healing, will result in an artistic-looking suture line, while the operation is not more difficult of performance, and is less time-consuming because the closure of the wound is easier. Bunts, in "Lewis' Practice of Surgery," is the only one who mentions that the surface area of the skin should be smaller than the surface of the breast area to be removed.

By gaining two and one-half to three inches of skin area by this method of partial skin conservation (Fig. 3), it will not be necessary to dissect the skin and undermine it beyond the circumference of the breast area, as it often must be done when the present classical incisions in vogue now are used.

According to Handley, some of the lymphatics lie directly below the skin, especially about the nipple, from whence they penetrate into the structure of the gland. This distribution radiates away from the integument towards the axilla, and towards the sternum through the pectoral muscles. But there is no direct lymph drainage or connection with the skin covering the breast.

Metastatic axillary lymph-node involvement is common in carcinoma of the breast, yet the skin covering the axilla is never removed, but the axillary contents, fat and lymph-nodes are dissected off of the skin covering the axilla.

All the recognized breast incisions do not sacrifice the skin covering the

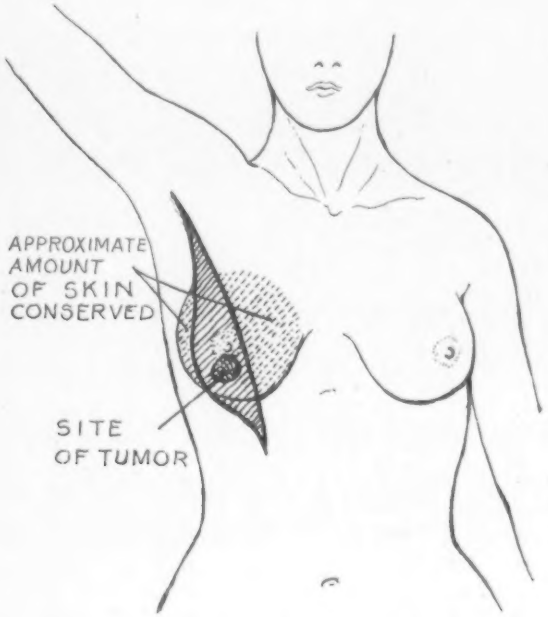

FIG. 4.—Tumor right lower quadrant. Dotted shading shows amount of skin conserved.

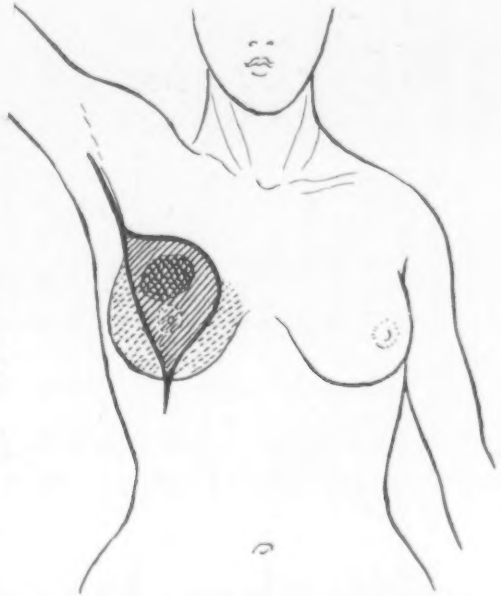

FIG. 5.—Tumor in middle upper quadrant. Dotted shading amount of skin conserved.

FIG. 6.—Tumor left middle and upper quadrant. Dotted shading amount of skin conserved.

axilla, though the axillary lymph-nodes are the seat of metastatic involvement. If it is important and necessary to remove the integument covering the breast far away from the tumor, the seat of carcinoma, how much more important would it be to remove the skin covering the axilla underlying which there are affected lymph-nodes. But this is never done. If it is safe, therefore, and it is, as experience teaches, to dissect and conserve the integument covering the axilla where axillary lymph-node involvement is present, is it not reasonable to feel the safety of dissecting and utilizing the integument of the breast opposite and distant from the tumor mass, so saving this extra amount of skin for easier closure?

While all the classical skin incisions for radical breast amputation have a well-defined outline, many provided with extensive side incisions for sliding flaps, in this suggested partial subdermal amputation, the outline of the skin incision is not constant but will depend upon the extent and location of the tumor, the amount of involved and adherent skin, as well as the good judgment and artistic sense of the surgeon. It must necessarily vary depending upon the above, as to how much skin can be conserved and dissected off the normal side of the breast. The underlying principle, however, remains the same, that is, that the skin covering the breast opposite to the tumor in the breast should be saved and dissected from the edge of the areola of the nipple, on to the outer circumference of the breast. In smaller tumors the skin of more than half the breast can be saved and be made available for easy suture.

Extensive conservation of skin in radical mastectomy has not to my knowledge been attempted nor its principles applied, probably because of the cancer fetish ever in mind. The entire breast, though the tumor may be a very small one, and the pectoral muscles are sacrificed, the pectorals, in many instances unnecessarily. I rarely remove them; certainly so far as the skin is concerned, the sacrifice is needless on the normal side of the diseased breast.

In plastic reconstruction of the pendulous breast the skin covering the entire mammary gland is dissected off, then after the breast is fixed in its new position, the skin is replaced without any injury to its viability, resulting in perfect healing. Having observed this surgical procedure there germinated the adaptability of skin conservation in breast amputation.

The method here suggested is a perfectly safe one, and while it has a very wide and varied applicability, it should not be attempted in cases which are far advanced nor where the skin covering the breast has been invaded or perforated. Even in cases with comparatively large tumor mass present, particularly in the scirrhous type of carcinoma, depending upon the good judgment of the surgeon, a considerable area of the skin can, nevertheless, with safety be dissected off the normal side of the breast opposite to whichever quadrant the tumor may be. Hæmostasis of the dissected flap must be thorough and kept covered with warm saline cloth while the major part of the amputation is completed. Retention sutures are usually not required. The outlines of the various incisions advocated are shown in Figs. 4, 5, and 6, which show also the amount of skin conserved compared with the total sacrifice.

OBSERVATIONS ON RUPTURE OF THE SUPRASPINATUS TENDON

BASED UPON A STUDY OF SEVENTY-THREE CADAVERS *

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Rupture of the tendon of the supraspinatus muscle is a common cause of shoulder disability.[1] Traumatic rupture of this tendon occurs fairly often and may be cured by suture at operation[2]; it is related to subdeltoid or subacromial bursitis but it may escape detection due to lack of appreciation of its prevalence. Many cases of rupture of this tendon may be found in individuals over fifty years of age, although whether all cases cause symptoms cannot at present be stated. A condition so widespread is worthy of more attention than it has received up to now, so that the present investigation seems warranted.

Anatomy.—The tendon of the supraspinatus muscle, usually about six centimetres long, arises from the muscle belly in the supraspinous fossa of the scapula and runs across the capsule of the shoulder-joint to insert into the highest of three facets on the greater tubercle of the humerus. During the terminal half of its course it is inseparable from the joint capsule. Its two borders may be distinguished from the adjoining borders of the tendons of the infraspinatus and subscapularis only with some difficulty. It forms the roof of the shoulder-joint and the floor of the subacromial bursa,† lying beneath the deltoid muscle and the acromial process of the scapula. Together with the tendons of the infraspinatus, the teres minor, and the subscapularis, it adheres to and greatly strengthens the capsule of the shoulder-joint.

Normally, there exists no communication between the subacromial bursa and the shoulder-joint.

Definition.—Throughout this paper the term "rupture of the tendon of the supraspinatus muscle" has been limited to those perforations of the tendon large enough to establish a direct and grossly visible communication between the subacromial bursa and the shoulder-joint. Mere erosions of the tendon near its insertion on the greater tubercle have been excluded. Gross changes of adjacent structures have been recorded.

Method and Material.—An unselected series of seventy-three successive dissecting-room cadavers was examined. Most of the shoulders were studied at the time medical students were dissecting the short rotator muscles of the humerus; others were examined by a special dissection; and one shoulder showing a large rupture was dissected and preserved as a museum speci-

* This investigation was aided by a grant from the Science Research Fund of the Rockefeller Foundation.

† According to Codman, the subacromial bursa is identical with the subdeltoid bursa.

men. (Fig. 1.) Miss Marie Olds and Mr. Irving Harris assisted in the examination of some of the shoulder-joints, while Miss Mary Schmeckebier illustrated the museum specimen appearing in Fig. 1; and for their assistance due acknowledgment is hereby made.

All cadavers had been handled with sufficient care during transportation, injection, and preparation for dissection to obviate the possibility of a post-

TABLE I

Table to Show the Incidence of Ruptured Supraspinatus Tendons Among Seventy-three Cadavers According to Race, Sex, Age and Side

		AGE	White Males	Negro Males	White Females	Negro Females	Totals
NORMAL CASES	with Both Tendons Intact.	Below 50	8	15	1	4	28
		Above 50	12	12	3	4	31
ABNORMAL CASES	with Both Tendons Torn.	Below 50	0	0	0	0	0
		Above 50	1	3	0	1	5
	with Right Tendon Alone Torn	Below 50	0	0	0	0	0
		Above 50	2*	1	1	0	4*
	with Left Tendon Alone Torn	Below 50	0	0	0	0	0
		Above 50	1	3	0	1	5
TOTALS			24	34	5	10	73

* In one of these cadavers the right shoulder alone was examined.

mortem rupture. Moreover, all the ruptures observed showed certain signs which indicated that they had originated during life.

The cadavers had been embalmed by injection into the femoral arteries of a solution of glycerine, alcohol and carbolic acid. The arteries had also been injected with starch colored by vermilion by way of the femorals or internal carotids. The shoulder-joints were all well preserved at the time of observation. The average period elapsing between the date of death and the date of dissection was twelve months, the shortest being three months and the longest twenty-four months.

Incidence.—Incidence based on lesions per cadaver differs from incidence

based on lesions per shoulder. Thus, if three cadavers were examined, and one found to possess tears of both tendons, one to possess a torn right tendon and a normal left tendon, and one to possess two untorn tendons, the incidence of the lesion among cadavers would be two out of three or 66.7 per cent., while the incidence among shoulders would be three out of six or 50 per cent.

Rupture of one or both supraspinatus tendons was found in fourteen out of the seventy-three cadavers, an incidence of 19.18 per cent.; it was found in nineteen out of 142 shoulders examined, an incidence for shoulders of

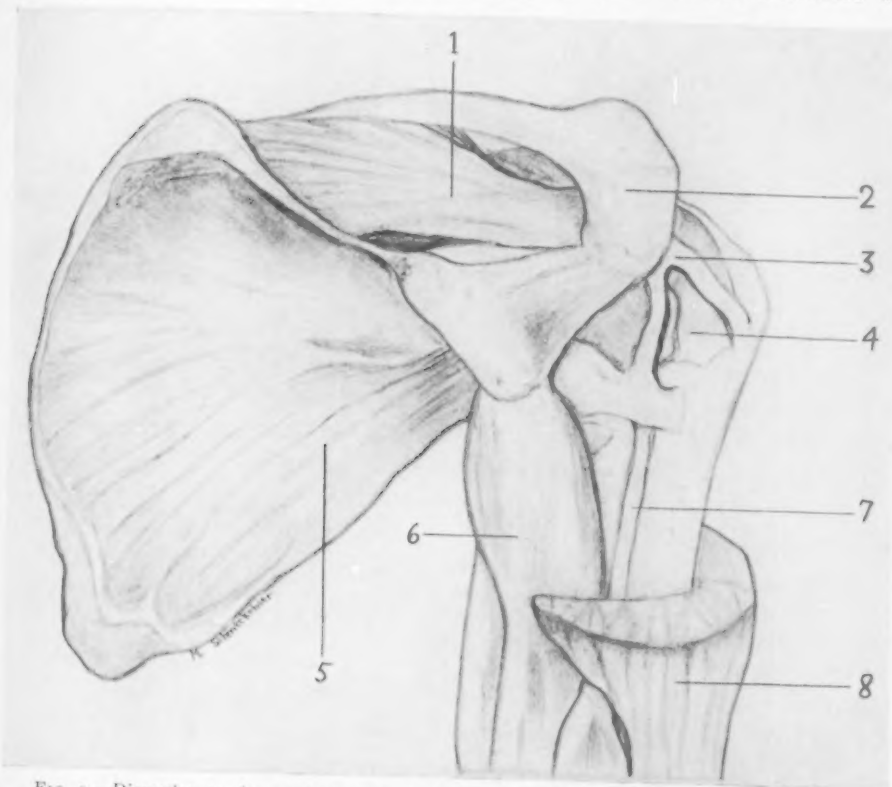

FIG. 1.—Dissection to show a large rupture of the supraspinatus tendon in the left shoulder of a Negro male aged eighty-six years whose right shoulder was the site of a similar smaller lesion. The clavicle and part of the deltoid muscle have been removed; the subacromial (subdeltoid) bursa has been dissected away to show the joint capsule with its inserting tendons. (1) Supraspinatus muscle; (2) acromion; (3) tendon of supraspinatus muscle; (4) tear in supraspinatus tendon; (5) subscapularis muscle; (6) coracobrachialis and short head of biceps muscles; (7) tendon, long head of biceps muscle; (8) deltoid muscle.

13.38 per cent. In four of the cadavers examination was limited to one shoulder.

Race.—The lesion occurred in five of the twenty-nine white cadavers, an incidence of 17.24 per cent.; it occurred in nine out of forty-four Negro cadavers, an incidence of 20.45 per cent.

Sex.—Eleven males out of fifty-eight had a torn tendon, an incidence of 18.97 per cent.; three females out of fifteen had a torn tendon, an incidence of 20 per cent.

Age.—The average age at death of all cadavers was 54.3 years; the average age at death of the cadavers possessing a ruptured tendon was 65.5 years. The youngest cadaver of the entire group was sixteen; the youngest cadaver with a torn tendon was fifty-one; no torn tendon occurred among the twenty-eight cadavers of the first five decades of life. All the fourteen cases of torn tendon occurred among the forty-five cadavers over fifty years of age, an incidence for this age group of 31.11 per cent. By decades the incidence was highest in the ninth, with two out of the four cadavers affected, an incidence of 50 per cent.; most cases occurred during the sixth decade with six affected out of the fourteen cadavers of that decade. The oldest cadaver with a torn tendon was eighty-six years of age, while the oldest cadaver of the group was eighty-eight years of age.

Shoulder Involved.—Both tendons were torn in five cadavers; one tendon only was torn in nine cadavers.* Of the unilateral tears, four* occurred in the right shoulder, and five in the left shoulder.

Relation of Age to Shoulder Involvement.—The average age at death of the cadavers with bilaterally torn tendons was 71.2 years; the average age at death of the cadavers* with unilaterally torn tendons was 62.3 years. The average age of cadavers with a unilaterally right-sided tear was 65.25 years, and of those* with a unilaterally left-sided tear was sixty years.

Description of the Lesion.—A typical lesion is illustrated in Fig. 1, and a description of it will include most of the features of other cases. The supraspinatus tendon may here be seen to split 0.7 centimetres lateral† to the acromion, and to proceed on either side of the tear to its insertion on the greater tubercle of the humerus. The tear or rupture in the tendon also pierces the underlying joint capsule, so that the joint cavity with some of the head of the humerus becomes revealed through it; in the undissected state the joint cavity would have opened through the rupture into the subacromial bursa. The shape of the rupture is triangular with the base along the greater tubercle, and perpendicular height parallel to the main axis of the tendon. The base measurement is 2.0 centimetres, the height 1.3 centimetres. A small bundle of fibres from the supraspinatus tendon remains traversing the rupture.

The torn tendon edges were seen in the original specimen to be smooth; but there was a little fraying of nearby portions of the tendon and of the long head of the biceps muscle. The greater tubercle was knobby and rough in its exposed portions, but normal elsewhere. Apart from the actual lesion the joint capsule as far as could be seen was smooth, and the inserting tendons of the short rotators were intact.

This description of one lesion covers the main features of all the other lesions of this series. The shape of all the ruptures was triangular, and all were confined strictly within the limits of the supraspinatus tendon. No tear of the supraspinatus tendon was complete or involved other tendons or

* In one of these, examination was limited to the right shoulder.

† The shoulder being in a normal resting position.

other parts of the joint capsule. One tear was so large that its apex disappeared beneath the acromion, the shoulder being held in a normal resting position; but all others lay lateral to it and were strictly "subdeltoid" in location. In general, the older the cadaver the larger were the tears.

Fig. 2 illustrates average-sized ruptures of the two supraspinatus tendons of one cadaver; the drawing is to scale and represents the position and extent of the lesions and the amount of supraspinatus tendon protruding lateral to the acromion. The lesion on the right side was considered of "medium" size, the one on the left "small."

The knobbing of the exposed parts of the greater tubercle of the humerus was subject to some variation in degree and extent. No calcium deposits were found in either the subacromial bursa or in the tendon edges. Erosions of structures forming the floor of the subacromial bursa, that is to say, erosions involving the superficial fibres of the supraspinatus tendon or involving the periosteum or deeper bony substance of the greater tubercle unless associated with a tendon truly torn were not classified in this study, although encountered not infrequently. One of these erosions, however, was so remarkable as to require special description. It occurred in the left supra-

FIG. 2.—Tracings to show relative size, shape, and position of ruptures of the right and left supraspinatus tendons of a Negro female of seventy years. (1) Distal part of supraspinatus tendon; (2) tear in the tendon.

spinatus tendon of a white female, seventy-eight years old. It was remarkable for its similarity in size, shape and location to a rupture occurring in the supraspinatus tendon of the opposite side; and it differed from it only by reason of the fact that it did not completely pierce its tendon but involved merely its more superficial fibres.

No microscopical studies were made of any of the material.

Relation to Disease.—The causes of death of cadavers with torn tendons differed little from the causes of death of the other cadavers. It was impossible to determine the influence on the lesion of acute trauma, as adequate case histories were not available.

DISCUSSION.—*Incidence per Cadaver.*—The incidence per cadaver for various series was, in round numbers 48 per cent. for Akerson,[1] 5 per cent. for Codman,[1] and 19 per cent. for this series.

Incidence per Shoulder.—This incidence was found to be in round numbers 39 per cent. by Akerson,[1] 5 per cent. by Codman,[1] and 13 per cent. by the author.

Reason for discrepancy of these figures: Akerson's series comprised necropsy material obtained from aged individuals with chronic diseases. As

will be shown later, the incidence increased with age; so that Akerson's group, being older, would therefore show a higher incidence than the present series. Codman's series comprised dissecting-room material, necropsy material, and operative cases. Unfortunately, he failed to keep accurate records so that his figures represent merely an estimate of his observations, as he himself admits.

Incidence among Whites and Negroes.—The incidence here for white cadavers was about 17 per cent.; the incidence for Negro cadavers was about 21 per cent. Race, therefore, would seem without influence upon incidence of the lesion.

Incidence and Sex.—Akerson mentions that some of his subjects were females, but fails to mention the distribution of the lesion among the sexes. The incidence here for females was 20 per cent., and for males was about 19 per cent. Sex, therefore, would seem without influence on the incidence of the lesion; but in drawing this tentative conclusion it should be noted that the number of females in the series was much less than that of males.

Incidence and Age.—All observers have noted that the lesion was more common in old individuals than in young; but concise figures have hitherto been lacking. This series yielded some facts of interest in this connection. All the cadavers below the fiftieth year had normal tendons. On the other hand, fourteen of the forty-five cadavers above the fiftieth year possessed a torn tendon, so that almost one out of every three cadavers of an older age was affected. The ninth decade showed a higher incidence of the lesion than any other, two of the four cadavers being affected.

The average age for cadavers with torn tendons was 65.5 years, or 11.3 years above the average age for the group. The youngest cadaver to show a ruptured tendon was fifty-one years of age.

Young individuals appear rarely to possess ruptured tendons. The youngest case of torn supraspinatus tendon recorded in the literature was a man of thirty-five who sustained a traumatic rupture of the tendon and who was operated upon and cured by Wilson.[2]

Shoulder Involved.—Akerson found fourteen cases of bilaterally torn tendons and eleven cases of unilaterally torn tendons. This series showed five cases of bilaterally torn tendons and nine cases of unilaterally torn tendons. In Akerson's series the bilaterals were found more often, in this the unilaterals.

Of Akerson's unilateral cases, nine appeared to be unilateral rights and two unilateral lefts. Of the unilateral cases of this series, four were unilateral rights and five unilateral lefts. Adding up the two series, the unilateral rights would outnumber the unilateral lefts.

Relation of Age to Shoulder Involvement.—Bilateral tears occurred in older cadavers, unilateral tears in relatively younger cadavers. Apparently the same causative agent is sometimes at work in both shoulders and perforates first one and eventually both supraspinatus tendons. In this connec-

tion it is interesting to note that the left unilateral tendon tears occurred in younger cadavers than the right unilateral tears.

Types of Tendon Tear.—All the ruptures of this series were strikingly similar one to another. All were triangular with the base along the greater tubercle. All were associated with a certain amount of tendon fraying and bony irregularity. The larger ruptures occurred usually in older cadavers, the smaller in younger.

Codman[1] says that occasional ruptures fail to perforate the floor of the subacromial bursa, but no such case was here observed.

Complete rupture of the supraspinatus tendon was not observed in this series. Wilson[2] has written an excellent article dealing with the clinical aspects and operative cure of complete rupture of the tendon; all his patients had completely ruptured supraspinatus tendons following trauma. The absence of this type of lesion in the present series might therefore be thought to indicate some other origin than trauma for the lesions encountered; although trauma probably causes a partial rupture at times.

Tears of adjoining tendons.—Akerson found that tears of one or all of the tendons of the subscapularis, infraspinatus and teres minor muscles often accompanied rupture of the supraspinatus tendon. No such accompanying tears occurred here. Meyer[3] reports occasional destruction of the long head of the biceps muscle and attributes it to constant wear associated with long-continued use. All biceps' tendons were here intact.

Origin of the Lesion.—A common origin for all the lesions of this series is indicated by their similarity to one another and by their close association with age. If there were several different causes for the lesion, more variety would be expected in their characteristics and in their distribution among age groups. All the lesions were found in cadavers over fifty and were usually larger sized in older cadavers than in younger. It would seem as if some process were at work in the tendon which progressed with years, gradually causing degeneration first of the floor of the subacromial bursa, then wearing through the tendon at its insertion into the greater tubercle, and finally causing a perforation or rupture of the tendon. What the process is, whether traumatic, infectious, degenerative or metabolic, is beyond the scope of this study to determine.

SUMMARY AND CONCLUSIONS

(1) Rupture of the tendon of the supraspinatus muscle occurs frequently. Its incidence among an unselected series of seventy-three dissecting-room cadavers was found to be 19.18 per cent.

(2) It occurred only in cadavers over the age of fifty years.

(3) Nine cases were unilateral, six were bilateral.

(4) The cadavers with unilaterally torn tendons were younger than those with bilaterally torn tendons.

(5) Four of the unilateral cases were rights, five were lefts.

(6) The cadavers with unilaterally right-sided torn tendons were older than those with unilaterally left-sided lesions.

(7) Race and sex were apparently without influence upon the distribution of the lesion.

(8) All lesions were remarkably similar to each other. There were no associated ruptures of other tendons.

(9) Age seemed the main factor influencing the distribution and character of the lesion.

(10) The process causing rupture of the supraspinatus tendon seems often to originate in the floor of the subacromial bursa, then to erode the superficial fibres of the tendon near its attachment to the greater tubercle and finally to perforate the tendon and joint capsule, thus opening up a communication between the subacromial bursa and the shoulder-joint. This process may act simultaneously and progressively in both shoulders.

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PRIMARY JEJUNAL ULCER

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Primary or simple jejunal ulcer is a lesion which is found infrequently. Many surgeons have had to care for the jejunal ulcer developing subsequent to a gastrojejunostomy. Few have had the opportunity of seeing or treating a patient suffering from such ulceration in the absence of previous stomach or duodenal surgery. While ulceration of the small intestines (more frequently the ileum) may occur in the course of typhoid fever, bacillary dysentery, cholera, and amœbic dysentery, the occurrence of a single ulcer (occasionally multiple) in the jejunum in the absence of profound systemic manifestations such as are seen in the acute enteric diseases noted above, is sufficient to arouse both interest and curiosity.

Incidence.—Judd,[30] in 1921, reviewing 4,324 gastrojejunostomies in which fifty-five gastrojejunal and jejunal ulcers had occurred, stated that not a single primary jejunal ulcer had been observed at The Mayo Clinic up to that time. Jancke,[27] in 1929, reporting several perforating ulcers of the small intestine, one of them jejunal, noted that only nine primary ulcers of the jejunum had been observed at The Mayo Clinic up to 1921. These two conflicting statements, the former from a surgeon of The Mayo Clinic and appearing in the American literature, the latter appearing in the German literature, deserve further elucidation.

Donati[27] (from Leotta), reviewing 8,060 autopsies, found gastric ulcers in 2.6 per cent., but not a single simple ulcer of the jejunum.

In this clinic from 1921 to 1932, 370 ulcers of the duodenum and jejunum were admitted to the surgical wards. Of this group, 319 came to surgery, and only two were primary jejunal ulcers. This frequency is somewhat above that commonly reported.

As Morrin,[44] Brown,[8] Schilling,[61] and Leotta[37] point out, a simple ulceration may occur in the ileum and Meckel's diverticulum. It seems illogical to include these ulcers in a clinical discussion of jejunal ulceration, although their pathology may be quite similar. In the majority of the reported cases, the jejunal ulcers appeared in the first loop and upper part of the jejunum. It is probable that ulcers in the ileum, Meckel's diverticulum, and even the lower jejunum, lacking the close proximity to the acid gastric and alkaline duodenal juices, have a different etiology from ulcers occurring in the stomach, pylorus, or duodenum. The relationship between these two types of ulcer is so remote that the latter may be excluded from a study of jejunal ulcers. While the symptoms of ileal and jejunal ulceration may closely simulate one another in the presence of perforation or obstruction, their dissimilarity becomes apparent when one studies jejunal ulcers that did not terminate in a perforative catastrophe.

From 1827 to 1932, only forty-seven (including author's case) primary

jejunal ulcers have been reported. Five of the reports are valueless for clinical study and have been added to the end of the table merely for completeness. The case of Moore,[43] so obviously traumatic with perforation into the urinary bladder, and the case of Pauchet[47] with multiple ulceration of the jejunum

TABLE 1.

PERFORATED JEJUNAL ULCERS.

(No Trauma)

Author.	Year.	Age.	Sex.	Prev. Ulcer Hist.	Operated.	Result.	Post Mort.	Location of Ulcer.	Other Ulcers.
Rufz (60)	1843	36	M.	Yes.	No.	Died.	Yes.	Upper jejunum.	3 in ileum.
Krauss (33)	1844	55	M.	-	No.	Died.	Yes.	Jejunum.	None.
deCastlenau (14)	1843	52	M.	-	No.	Died.	Yes.	Mid. jejunum.	None.
Perroud (50)	1867	32	M.	Yes.	No.	Died.	Yes.	Upper loop.	None.
Parenski (49)	1876	45	M.	-	No.	Died.	Yes.	Lower jejunum.	4 in jejunum.
Kronlein (35)	1886	61	M.	None.	Yes.	Died.	Yes.	Jejunum.	2 in jejunum.
Brigidi (7)	1893	-	M.	-	No.	Died.	Yes.	Upper jejunum.	1 in jejunum & 1 in ileum.
Kirmisson (32)	1898	8	M.	None.	Yes.	Lived.	No.	Jejunum.	None.
Jankowski (28)	1908	48	M.	None.	No.	Died.	Yes.	Lower jejunum.	1 in jejunum.
Lett (39)	1919	54	F.	Yes.	Yes.	Lived.	No.	Upper jejunum.	None.
Cade (10)	1913	25	M.	Yes.	No.	Died.	Yes.	Upper jejunum.	None.
Bryan (9)	1916	48	M.	Yes.	Yes.	Died.	No.	Upper loop.	None.
Kretschmar (34)	1920	39	M.	Yes.	Yes.	Died.	No.	Jejunum.	None.
Fischer (18)	1921	58	M.	Yes.	Yes.	Lived.	No.	Upper loop.	Old duodenal etc.
Richardson (56)	1922	47	M.	Yes.	Yes.	Lived.	No.	Upper jejunum.	None.
Richardson (56)	1922	48	F.	Yes.	Yes.	Lived.	No.	Mid. jejunum.	None.
Holtzweissig (26)	1922	58	F.	None.	Yes.	Died.	Yes.	Upper loop.	10 in jejunum.
Chiasserini (11)	1922	-	M.	-	Yes.	Died.	-	Upper loop.	
Velte (72)	1924	77	F.	None.	Yes.	Lived.	No.	Upper jejunum.	None.
Barber (3)	1926	33	M.	Yes.	Yes.	Lived.	No.	Upper loop.	Old pyloric.
Schilling (61)	1930	47	F.	None.	No.	Died.	Yes.	Mid. jejunum.	None.
Black (4)	1930	53	M.	Yes.	Yes.	Lived.	No.	Upper jejunum.	None.
Morrin (44)	1931	65	M.	Yes.	Yes.	Died.	-	Upper jejunum.	None.
Morrin (44)	1931	39	F.	-	No.	Died.	Yes.	Upper jejunum.	None.
Morrin (44)	1931	47	F.	Yes.	Yes.	Lived.	No.	Jejunum.	None.
Smith (67)	1932	27	M.	Yes.	Yes.	Lived.	No.	Upper jejunum.	None.

which presented no clinical or pathological characteristics of the usual simple ulceration, are omitted entirely. Of the forty-two cases in which the available data were sufficient for interpretation, but seven (author's case included) were operated on in the absence of perforation. The remaining thirty-five cases

(Table I) had perforated and, in this group, nine (Table II) are questionable because of the possibility of associated trauma having been responsible for the perforation.

Primary Jejunal Ulcer without Perforation.—A survey of the literature disclosed but six cases in which surgery had been performed because of digestive complaints and in the absence of perforation.

CASE I.—Schmilinski,[62] 1910, female, aged sixty-three. Pain in the stomach for years. X-ray showed obstructive incompetence of the stomach and duodenum. A diagnosis of duodenal ulcer was made, and at operation the duodenum and jejunum were found to be dilated, with a stenosing induration of the jejunum and adjacent mesentery four centimetres from the duodenojejunal fold. Resection. A chronic ulcer was found on the mesenteric border. No evidence of lues or tuberculosis. The patient survived.

CASE II.—Murphy,[45] 1916, male, aged sixty-two. Digestive trouble for fifteen years. Pain occurred from one to three hours after meals. X-ray showed obstruction to the outlet of the stomach. A diagnosis of duodenal ulcer was made, and at operation an extensive inflammatory induration was observed about the duodenum which indicated the site of an ulcer. A second ulcer was noted in the first part of the jejunum. Anterior gastrojejunostomy was performed. The patient survived.

CASE III.—Walton,[74] 1922, female, aged forty-five. Stomach trouble for nineteen years, with epigastric pain of a periodic nature occurring late after food and relieved by food. X-ray showed an extraneous stomach mass with no evidence of obstruction. The diagnosis was uncertain. At operation an indurated and inflamed area about three feet from the duodenojejunal fold was discerned. Resection. The ulcer was round and compared in every way to a chronic gastric ulcer. No evidence of tuberculosis or lues. The patient survived.

CASE IV.—Fischer,[19] 1923, female, aged forty-two. Epigastric pain of a periodic and constricting nature for one year. Melæna. X-ray examinations were repeatedly inconclusive. Diagnosis was uncertain. At operation an indurated area was found at the duodenojejunal junction. The gut was irregular, thick and œdematous, with a scarlet serosa covered with fibrin. Duodenojejunostomy. Since there was no pathological specimen malignancy could not be ruled out. The patient survived.

CASE V.—Ravdin,[53] 1927, male, aged forty-two. Dull epigastric pain two hours after food, associated with belching and relieved by soda. Six months' duration. X-ray examinations were negative. Diagnosis was duodenal ulcer, and at operation no ulcer was found; however, an appendectomy was performed. The patient became worse, and three months after the first operation X-ray examination showed a high jejunal obstruction. At a second operation the jejunum was found to be dilated to about twelve inches from the duodenojejunal fold where there was an annular sclerosing mass with enlarged lymph-nodes in the adjacent mesentery. Resection. The ulcer was of the chronic type. The patient succumbed.

CASE VI.—Pickhardt,[52] 1930, female, aged sixty. Intermittent, general abdominal cramps, with vomiting. Three weeks' duration. Barium enema showed a twist at the sigmoid. Diagnosis was partial intestinal obstruction and at operation a circular stricture was found at about five feet from the duodenojejunal fold. Resection. The ulcer was of the chronic type. No evidence of a vascular lesion. The patient survived.

Our own case brings the number of reported cases up to seven. It appears to be the only one reported in which actual diagnosis of jejunal ulceration was made prior to operation. The history follows.

CASE No. 22834.—O. P., colored male, aged thirty-six. Admitted to the surgical service of Dr. E. L. Eliason at the Hospital of the University of Pennsylvania October 6, 1931, and discharged October 26, 1931. *Chief Complaint.*—Stomach trouble. *History*

of Present Illness.—Patient was apparently well until 1925, when he began to suffer from indigestion. He described his first attack as having followed the eating of grapes during the afternoon and a supper which did not digest that evening. He had a sour taste in his mouth and vomited the following morning. Vomitus was liquid, light in color, and sour. There was no blood. Following this attack he suffered from a continuous pain in the mid-epigastrium, persisting over a period of from six to eight weeks. The pain was somewhat relieved by belching, but was apparently not severe because the patient was able to continue doing light work. There were intervals of complete freedom from symptoms which lasted for several months at a time.

In 1927, the patient suffered from melæna; black stools persisted for five days. He had some loss of appetite, but very little pain. He remained under a physician's care for three or four months at that time.

In September, 1930, the patient had a most severe attack of indigestion with vomiting of food and bile associated with epigastric pain. He was admitted to the Atlantic City Hospital where he remained for a period of ten days. A röntgenological study was not made. He was placed on a Sippy diet, to which he strictly adhered for four months. This diet was then modified and continued with little alteration to the present time.

The pain associated with the attacks of indigestion was described as being in the mid-line of the epigastrium. It was lancinating in type, as though a person took a razor and kept making short cuts. Pain of this type would also occur about one hour after meals with occasional relief after food or alkaline powders. Further points in the history of present illness are not essential.

Past Medical History.—Malaria at eight years of age while living in South Carolina. No history of typhoid fever or dysentery. Denied venereal disease. Denied penile sore. In 1922, the patient developed a suppurative left inguinal adenitis which was diagnosed as luetic. A single positive Wassermann was obtained. The adenitis promptly subsided after incision and drainage. He received intravenous and intramuscular therapy in 1922 and intravenous therapy in 1923. During the course of treatment, and since that time, up to one year ago, his Wassermann has been repeatedly negative. No other operations. Family history and social history irrelevant.

Physical Examination.—Patient was a slender, poorly nourished colored male, thirty-six years old, who appeared to be ill. Temperature, 99° F.; pulse, 80; and respirations, 22. Scalp, nose, ears, eyes, mouth, neck, lungs, cardiovascular, and extremities were grossly negative. The abdomen presented moderate tenderness to palpation in the left upper quadrant, and in the epigastrium.

Laboratory Studies.—All within normal limits. The blood Wassermann was negative. Fæces strongly positive test for occult blood on meat-free diet. Fractional gastric analysis after test meal. No free acid in any of the six specimens or fractions. The quantity withdrawn was only sufficient to determine a total acid of twenty-two in the sixth specimen. Both the fasting and residue specimens showed a trace of occult blood. Both showed white blood corpuscles and epithelia.

Röntgenological Studies.—Gastro-intestinal series. Œsophagus, negative. Stomach, negative. Duodenum, cap negative by screen examination, unfilled on the films. Stasis in the duodenum and jejunum with obstruction in the first part of the jejunum due to ulcer or adhesions. (Fig. 1.) Remainder of small intestine, negative.

Pre-operative Diagnosis.—Jejunal ulcer.

Operation.—Under spinal (neocaine) supplemented with gas-ether anæsthesia a mid-line incision was made from the ensiform to the umbilicus. Stomach, prepylorus, pylorus, and duodenum were first examined and found to be entirely normal. Gall-bladder normal. Examination of the jejunum revealed a stenosing lesion involving almost the entire circumference of the bowel and causing a partial obstruction six inches from the ligament of Treitz. The bowel proximal to the stenosis was distended and hypertrophied. Palpation revealed only moderate induration and the impression was that the condition was probably a jejunal ulcer.

Approximately four inches of the jejunum were resected, thus completely removing the ulcer-bearing portion of the bowel. After inversion of the cut ends of the proximal and distal jejunum, continuity was restored by lateral anastomosis.

Progress.—Patient reacted promptly and satisfactorily after operation. Wound healed by primary union and the patient was discharged from the hospital on the seventeenth post-operative day much improved.

Pathological Report.—Specimen consisted of part of the jejunum which measured about five centimetres in length. (Fig. 2.) In the middle there was an annular ulcerating lesion. The ulcer was shallow, and its base was covered with small blood-

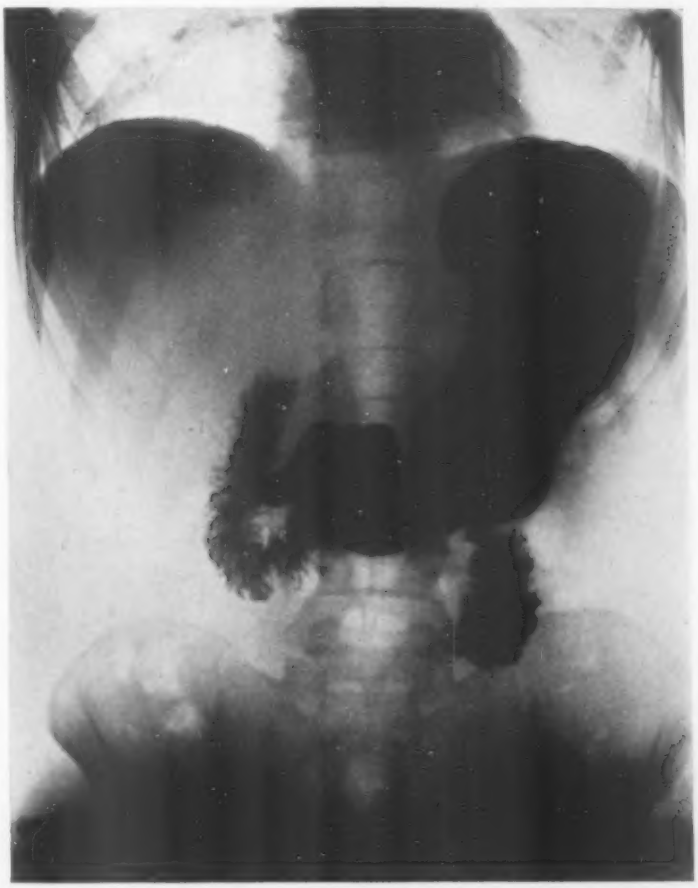

FIG. 1.—Röntgenogram showing dilated proximal jejunum and acutal site of stenosis. (Spasm.)

clots. There was no gross evidence of infiltration. Sections showed the ulceration down to the muscularis mucosa. (Fig. 3.) There was small round-cell infiltration and fibrosis. No evidence of tuberculosis. Levaditi stain did not demonstrate any spirochætes.

Follow-up Examination.—Approximately five months after operation. Slight post-prandial epigastric discomfort immediately relieved by alkali. Otherwise completely relieved of symptoms, and feeling much improved. X-ray showed slight widening of the lumen in several coils of small intestine in the left upper quadrant, with small amount of regurgitation, but no obstruction. Hypomotility.

Etiology and Pathogenesis.—An enteric fever (typhoid), bacillary or amœbic dysentery, or cholera, however remote, may serve as the initial factor

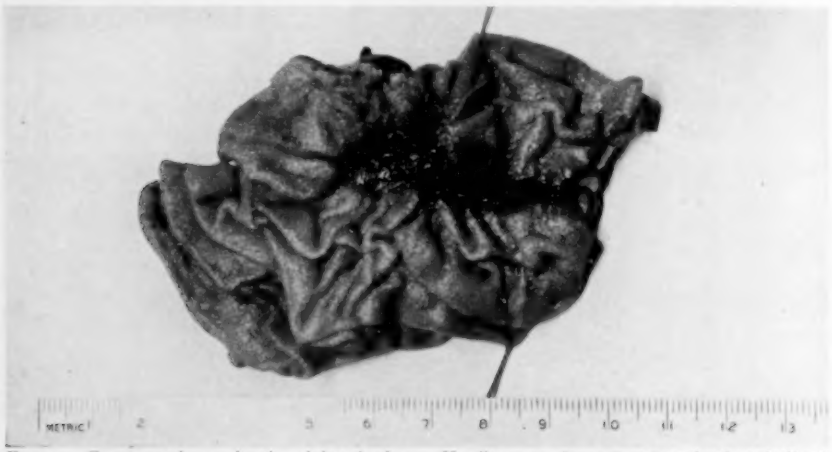

FIG. 2.—Gross specimen showing jejunal ulcer. Needles are situated at proximal and distal ends of specimen.

in the production of jejunal ulcer. Later, the ulcer may be maintained through the irritative action of the acid or alkaline intestinal chyme, thus attaining

FIG. 3.—Low-power section through side of ulcer. Mucosal ulceration. Muscularis slightly broken. Fibrosis and round-cell infiltration. Levaditi stain negative for spirochæta pallida.

clinical significance. This concept would appear to agree with that of Bolton,[5] who believed that most acute ulcers healed rapidly and that chronic ulcers

resulted only from unhealed lesions. He worked with gastric and duodenal ulcers.

There was a tendency in the earlier reports to use the term "peptic" ulcer instead of primary jejunal ulcer. This terminology is open to serious question. In three of the collected cases, (Schmilinski,[62] Walton,[74] and Smith[67]), as well as in our own, there was an absence of, or at least very low free hydrochloric acid in the gastric secretion as shown in the fractional gastric analysis of the test meal. The histamine test was not used. In the presence of these findings, one finds it difficult to accept the term "peptic ulcer," which implies the action of the acid gastric juices. Acid intestinal contents have been observed in the jejunum (Roeder[57]). Mucous membrane similar in character to that of the gastric mucous membrane has been observed in the small intestine and in Meckel's diverticulum (Nicholson,[42] Sweet,[70] Stone,[69] and Hartglass[25]). Grassman[24] reported success in producing ulcers in the small bowel of dogs as a result of tryptic digestion. While it is highly improbable that the acid concentration of the jejunal contents might rise to singularly abnormal heights, one such case has been observed by Holtzweissig.[26] In this case, because of obstruction of the ampulla of Vater, the acid gastric juices were not neutralized.

Cornioley[12] believed that simple ulcers were always preceded by local circulatory difficulty manifested as an endarteritis of the arterioles in the submucosa of the bowel. In older patients vascular changes may exist, while in younger ones a metastatic bacterial embolus may produce the ulceration. This type of ulcer will have no tendency to become chronic, but is likely to perforate at any time from its inception. The majority of the ulcers in the collected case reports were of the chronic type. One cannot readily support the hypothesis that the embolic factor is of importance in the absence of any demonstrable source of the emboli or of any other embolic phenomena. In reviewing the literature, it was noted that several authors stated that no vascular changes were evident, although some case histories were not explicit as to whether or not any vascular changes had been noted in the microscopical sections.

Rosenow[58] believed and proved rather conclusively in animal experimentation that specific strains of streptococci produce intestinal ulceration. A few cases of small intestinal perforation incident to focal infection have been reported. Gale[20] cited a case of repeated intestinal perforation in a woman, aged forty, each perforation having been preceded by furunculosis of the external auditory meatus. Lemierre and Levesque[38] reported ulceration of the ileum due to pneumococcal infection and isolated the organism from the ulcer, the primary focus being in the lungs. Pesce[51] similarly noted the association of tonsillitis with perforation of an ulcer.

Intestinal ulceration may occur in uræmia. Dickinson[15] reported eleven cases of uræmic ulcers of the small intestines. These ulcers were regular in outline, circular, punched-out, and without thickened edges. He stated that perforation was common in this type of ulcer. These ulcers are probably not unlike those which occur after severe burns and, experimentally, after partial[41] or total[40] destruction of the adrenals, or exclusion of pancreatic juice by ligation of the pancreatic duct.[17]

Friedman[21] adheres to the view that excess or deficiency of endocrine secretion acts directly on the walls or on the vessels of the whole gastro-intestinal tract, and that small areas become devitalized through this interference with their blood supply. Ulceration would then ensue through bacterial invasion or because of the caustic action of the hydrochloric acid.

Ulceration commonly occurs at the site of carcinoma or new growth and, as in the case cited by Renon and Blatmoutier,[54] ulceration and perforation of the small intestine occurred secondary to obstruction due to carcinoma. Paterson Brown[8] cautioned against the inclusion of such ulceration in a collection of so-called primary jejunal ulcers. Two carcinomata of the small intestine have been observed personally, both with subacute obstruction, and in neither instance was such proximal ulceration noted, although there

was slight local ulceration of the new growth. Papin[46] reported a carcinoma of the appendix with ulceration.

Trauma may be the initial cause of chronic ulceration and, in some cases, will be directly responsible for perforation. The case reported by Moore,[43] which I have excluded from the series of perforated ulcers, is an example of this type. Simmons and von Glahn[65] failed to produce ulcers after the administration of ground glass to dogs. In nine of the ulcers presented under the perforated group, the question of trauma as an etiological factor arises. It is entirely possible that the ulcer was already present in several of these cases, the trauma actually provoking the perforation. The cases reported by Dodson,[18] Reverdin,[55] and Wagner[73] probably belong to this group for the ulcers noted at autopsy were of the chronic type. Four ulcers were known to be acute. In the case cited by Friele,[22] the cause of ulceration was a blow to a truss worn by the patient. Sestier's[64] patient had a strangulated hernia, and ulceration occurred about the strangulation. Simpson's[66] case was a dement, and at autopsy the intestinal tract was found to be filled with wood fibres, although none was presenting through the site of ulceration, nor were any fibres reported in the peritoneal cavity. Jankowski's[29] case (1910) perforated after a meal of cherries and at autopsy large masses of cherry stones were found in the intestinal tract. It was assumed that a sharp edge on one of these stones was responsible for the perforation. However, in this same case, the patient had suffered a severe attack of abdominal pain twenty years previously. The exact significance of this attack is not apparent, although one might conclude that some previous ulcer had perforated. In two of the remaining nine cases, while the author concluded that perforation was due to trauma, the exact nature of the trauma was not mentioned.

Tuberculosis must be excluded as an etiological factor in the production of simple jejunal ulceration. In those cases in which no specimen is available, the presence of a pulmonary or laryngeal tuberculosis and, possibly, the identification of acid-fast bacilli in the stools would lead one to suspect the presence of a tuberculous ulcer. The presence of tubercles in the ulcer would enable one to make a positive diagnosis. Cruice,[13] in 1911, in an extensive review of the literature to that date, quoted numerous writers and noted that intestinal ulceration occurred in from 29.9 per cent. to 90 per cent. of cases of pulmonary phthisis for separately reported series. He also noted that perforation of ulcers of acid-fast origin occurred in from 1 to 5 per cent., the former being the more nearly accepted figure. Richardson,[56] reporting 4,200 autopsies at the Massachusetts General Hospital, found forty-nine cases of tuberculous ulcers, in forty-three of which the ileum was involved, and in five of which the jejunum and ileum were both involved. Gross perforation was found but three times, and then in the ileum. Lazerevic[36] reported a stenosing tuberculous ulcer of the jejunum which led to perforation. The tuberculous nature was disclosed at microscopical examination. While some of the writers omitted to mention that there was no evidence of tuberculosis, none gave any data to support the view that the tubercle bacillus was responsible for the production of the ulcer.

The exclusion of syphilis as an etiological factor is most difficult. Syphilis may produce intestinal ulcerations. Fraenkel,[20] in a series of 19,000 autopsies, reported three cases of acquired syphilis of the small intestine, one an ulcer in the ileum, and two in the jejunum. Weiss[75] reported perforation seven times in thirty-five cases of syphilis of the intestines. Obendorfer[46] reported

twenty-four cases of acquired lues, five of which had an associated gastric syphilis. Eighteen of these cases had ulcers in the small intestines, nine of which appeared in the jejunum alone, or in the jejunum and ileum. Two of these perforated. Arkin,[1] in a thorough discussion of syphilitic intestinal ulceration, came to the following conclusions: (1) Acquired luetic ulcers frequently occur in the jejunum. (2) The spirochæta pallida are present in these ulcers. (3) The changes are usually submucosal: (*a*) gummatous ulceration, (*b*) endarteritis, (*c*) endophlebitis, (*d*) advanced miliary phlebitis, (*e*) endothelial-cell proliferation. (4) Acquired luetic ulcers are usually accompanied by changes in the liver, spleen; rarely in the brain, thyroid, adrenal, pancreas, and long bones, except the tibia. (6) Diagnosis of the lesion can be made by (*a*) demonstration of the spirochæte in the lesion, (*b*) vascular changes, (*c*) other luetic lesions, (*d*) absence of tubercles in lesions, glands, or liver, (*e*) absence of tubercles on the serosa, (*f*) frequent location in the jejunum.

Karsner[31] states that luetic lesions of the intestinal tract occur late in the acquired form of syphilis as gummata. They particularly affect the rectum, sigmoid, and other parts of the colon, but are rarely observed in the small intestine. The gumma breaks down to form an ulcer of the chronic type, often extending transversely across the gut. There is usually a necrotic central mass surrounded by endothelial or lymphoid cells in association with well-marked chronic inflammation in both arteries and veins which may undergo actual occlusion. Cicatricial contraction of the intestine is common, due to fibrosis.

In the reported case this problem deserves unusual consideration. It is worthy of note that this patient suffered from inguinal buboes which suppurated three years prior to any gastric symptoms. His physician made a diagnosis of syphilis on a single Wassermann reaction. The patient then received a fair course of antiluetic therapy for two years. All subsequent Wassermann reactions were reported as negative, even during the course of therapy. The patient denied having had a primary penile lesion. The Wassermann reaction while under our care was negative. This was ten years after the initial diagnosis of syphilis.

According to Stokes,[68] inguinal buboes appear in only 30 to 40 per cent. of those cases presenting actual chancre, and suppurate in few instances. A single positive Wassermann reaction does not make conclusive a diagnosis of syphilis. It is highly probable that this patient did not have syphilis in the first place. If he did have syphilis, a fairly intensive course of antiluetic treatment was given, and all subsequent Wassermanns were negative, even ten years after the possible inception. The gross microscopical and Levaditi pictures of the ulcer removed showed no evidence of syphilis. The patient presented no stigmata of the syphilitic.

In a few of the reported cases, the question of lues arose. Fraenkel[20] thought that Schmilinski's[62] case might be syphilitic. The Wassermann reactions in four of the non-perforative ulcers were negative. The remaining three were not reported. Only two of the cases in the perforative series

had negative Wassermann reactions (Black[4] and Morrin[44]), while Richardson reports negative Levaditi stains on two specimens. The remainder of the series presented no Wassermann reports.

This problem is best summed up in the words of Richardson,[56] "The proof that a lesion of the small intestine is syphilitic is not easy. . . . There is no conclusive point by which the nature of the syphilitic lesion may be recognized in all its stages unless the spirochæta pallida is demonstrated in the lesion. Conversely, the exclusion of syphilis as the cause of intestinal ulceration is correspondingly difficult."

A review of the literature brings out the fact that the etiology of jejunal ulcer is as obscure at present as is that of the more common duodenal, pyloric, or gastric ulcer.

Pathology.—Thirty-four of the entire series (forty-two) were localized as to the portion of the jejunum they occupied. Of the non-perforated group, four were within the first or upper loop of the jejunum, two were in the upper jejunum, and one in the mid-jejunum. Of the perforated group, nine were in the first or upper loop, ten in the upper jejunum, four in the mid-jejunum, and four in the lower jejunum. The majority of the ulcers were obviously in the upper jejunum. One is led to conclude from the predilection of this ulceration for the proximal portion of the jejunum that these lesions are possibly entirely different from those ulcers which occur in the ileum where known specific ulcerations are the result of invasion of the aggregate lymph patches.

The majority of the ulcers were situated opposite to the mesenteric attachment. Of the two cases in the non-perforated group in which the relation to the mesentery was recorded, one was antimesenteric, and the other was near the mesentery. In the perforated group in which this point was recorded, sixteen were antimesenteric, and two were near the mesenteric attachment.

Apparently chronicity tended to stricture formation. In four of the non-perforated ulcers where stricture formation had been noted, all were of the chronic type. In the perforated group, seven of which showed stricture formation, six were recorded as having been chronic. The seventh history failed to state whether or not the ulcer was chronic. The formation of a stricture implies actual stenosis due to scar-tissue infiltration. However, in the reported case, the stenosis was due in large part to constricting spasm of the ulcer-bearing portion of the jejunum.

The descriptions of the ulcers were practically the same. They were often described as being exactly similar to the chronic peptic ulcers occurring in the stomach or duodenum. They were clean-cut and punched out. In cross-section they tended to show a terrace formation of the edges. The degree of induration was variable. The size varied from that of a pea to the size of a small coin (two centimetres). The perforated ulcers usually presented a minute opening described variously as the size of a knitting needle, lentil, or a coin, the former measurements predominating. In several instances the minuteness of the perforation was responsible for the surgeons' failure to

find the ulcer and its perforation. The mucous membrane participated to a greater extent in the necrotic process.

The configuration of the ulcers was predominately circular. While some of the records were not explicit in this particular, three histories of the non-perforated group state that the ulcers were circular and two that they were annular. Of the perforated group, thirty-one were recorded as being circular, and six annular.

Microscopically, the ulcers showed varying degrees of round-cell infiltration and fibrosis. Necrosis varied from the superficial mucous-membrane destruction to the involvement of the submucosa and deeper layers, and to actual perforation through the serosa. While several microscopical reports definitely stated that no vascular changes were apparent, none reported actual characteristic alterations other than thrombosis. Chronicity predominated. In those ulcers in which the observation was recorded, twenty-three were chronic, three were subacute, and six acute. Four of the acute ulcers in the group occurred or perforated after trauma.

Few of the writers recorded the presence or absence of enlarged regional lymph-glands (mesenteric). In those instances in which these glands were examined microscopically, the changes noted were those due to chronic inflammation. The presence or absence of glands would lead one to speculate on the possibility of malignancy.

Additional ulcers were observed in nine of the cases. Parenski's,[49] Kronlein's,[35] and Jankowski's[28] all showed two or more ulcers in the jejunum. Holtzweissig's[26] case showed eight ulcers in a ten-centimetre area of the jejunum. Rufz's[60] case had three ulcers in the ileum, and the case history was very suggestive of a previous enteric fever. Brigidi's[7] case showed an ulcer in the ileum. Fischer's[18] case showed an old healed duodenal ulcer and numerous chronic infiltrations in the bowel wall distal to the position of the reported ulcer. Barber's[3] case showed an old healed pyloric ulcer, and this patient had been operated upon twice previously for perforated ulcers of the stomach. Murphy's[45] case had a duodenal ulcer. The presence of associated ulcers in the ileum leads one to suspect that one of the enteric fevers was a causative factor. The presence of additional ulcers in the jejunum is of interest, particularly in view of the fact that two or more ulcers in the duodenum are often seen at operations for peptic duodenal ulcer.

Symptomatology.—In those histories in which the patients' ages were recorded, the primary jejunal ulceration was found to have occurred between the ages of eight and seventy-seven. The majority of the cases appeared between the ages of thirty-one and sixty, predominantly from forty to sixty. Likewise, where sex was recorded, ulcers occurred in thirty males and eleven females, making a ratio of three males to one female. (Fig. 4.)

In the non-perforated series, gastric complaints were manifest for from three weeks to fifteen years. While the predominant complaint was pain in the stomach, epigastrium, or general abdomen, five patients presented

symptoms not unlike those noted in cases of peptic ulcer of the duodenum; the pain occurred from one to three hours after meals, occasionally late at night, and was relieved by food or alkalies. Pain was occasionally referred to the back, right upper quadrant, or lower abdomen. Periodicity was recorded in five cases, and it is interesting to note that the one ulcer three feet beyond the duodeno-jejunal flexure presented symptoms of this character. In those ulcers which caused stenosis, subacute obstructive symptoms were manifest, such as cramp-like pains, distension, vomiting, with some

Cases.

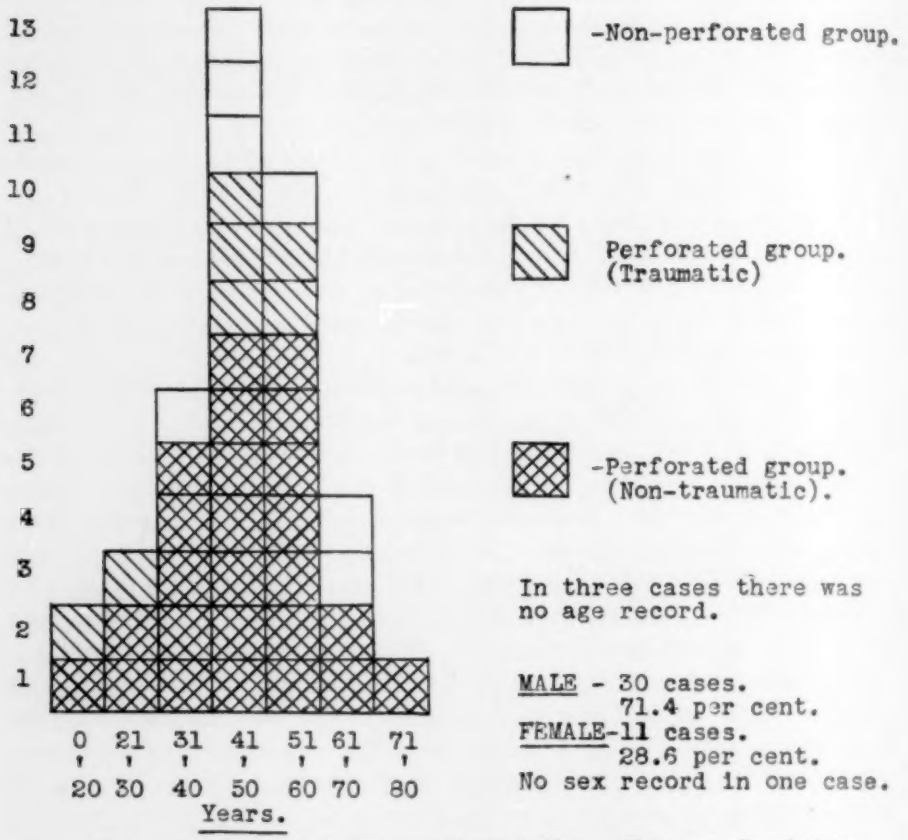

FIG. 4.—Primary jejunal ulcer-age and sex incidence. Forty-two collected cases.

relief by lavage. Melæna was recorded in two cases. Hematemesis was observed in Murphy's[45] case. However, the presence of an associated duodenal ulcer minimizes the value of this observation. Constipation was occasionally recorded.

In the perforated group, seven of the cases were entirely free of digestive complaints up to the actual time of perforation. Thirteen of the records failed to comment on this point. The remaining fifteen presented variable symptoms. Ten of the cases had symptoms of a dyspeptic nature for a period ranging from two months to six years. Indigestion was the com-

plaint in four instances. Pain of a colicky nature, heart-burn, stitch in the side, pain in the epigastrium or lower abdomen was recorded in ten. Melæna was noted only in two. Symptoms of an obstructive nature, such as distension, constipation, belching, nausea and vomiting were observed in eight cases. In only three cases in which previous symptoms were recorded did the digestive complaints, or pain, simulate or suggest the presence of a peptic ulcer as outlined under the non-perforative group.

The perforative catastrophe was announced by a sudden, severe, and occasionally colicky pain in the abdomen. In two instances in which the perforation might have been called subacute, there was only an increased severity

TABLE II

PERFORATED JEJUNAL ULCERS.

(History of Trauma)

Author.	Year.	Age.	Sex.	Prev. Ulcer Hist.	Operated.	Result.	Post Mort.	Location of Ulcer.	Nature of Trauma. Other Ulcers.
(64) Sestier	1827	-	-	None	-	Died.	-	Jejunum.	Strangulated hernia with ulceration.
(73) Wagner	1858	18	M.	-	No.	Died.	Yes.	Upper loop.	Buried by earth.
(71) Taylor	1865	45	M.	-	No.	Died.	Yes.	Jejunum.	Fall;wrestling and drinking.
(55) Reverdin	1867	55	M.	-	No.	Died.	Yes.	Mid. jejunum.	Intoxicated and fell.
(66) Simpson	1897	56	M.	-	No.	Died.	Yes.	Upper loop.	Dement. Wood fibers in int. tract.
(16) Dodson	1906	57	M.	-	No.	Died.	Yes.	Lower jejunum.	Abdominal bruise.
(29) Jankowski.	1910	42	M.	-	Yes.	Died.	Yes.	Lower jejunum.	Cherry stone meal.
(22) Friele	1894	46	M.	Yes.	Yes.	Lived.	No.	Jejunum.	Struck truss.
(27) Jancke	1929	28	M.	-	-	Died.		Upper loop.	Trauma (?)

of the past complaint, pain. In only two of the twenty-six perforated ulcers not associated with trauma did the records omit these notes.

In those perforated ulcers associated with trauma, only five of the nine patients complained of pain in the abdomen. The remaining histories did not comment on this point. (Table II.)

The pain heralding the perforation was general in fifteen cases. The remainder presented some localization. Epigastric pain was mentioned in four, umbilical in three, lower abdominal in seven, pain in the lower right quadrant in one, lower left quadrant in four, and upper left quadrant in one. It is interesting to observe that in no case was the pain, either by early or late localization, referred to the right upper quadrant, and, in only

one instance, to the lower right quadrant. The pain reference was extremely variable and was recorded in only seven cases. Reference to the thighs, shoulders, back, loin, and flank were mentioned.

Obstructive symptoms—distension and constipation, were noted in nineteen cases, while vomiting was recorded in seventeen. The signs of peritonitis—a rigid, silent, and tender abdomen, were recorded in twenty-seven cases, the remaining eight having failed to comment on this point. The abdominal rigidity was usually board-like. Liver dullness was absent or diminished in seven cases in which observations on this point were made.

Diagnosis.—It has been exceedingly difficult to form a clear and concise clinical picture of this condition from the data collected. Much of the desired information has been omitted from the records or case reports, and the material available has often been entirely inadequate for analysis.

Indigestion and dyspepsia lasting from months to years with pain, usually epigastric, occurring from one to three hours after meals, tending to be periodic, and occasionally relieved by food or alkalies, should lead one to suspect a peptic ulcer. While the ulcer may be, and usually is duodenal, the jejunum must not be excluded. Stenosis of the bowel will add such obstructive symptoms as distension or flatulence, belching, vomiting, constipation, and colicky pains which are often relieved by gastric lavage. Only two cases (Schmilinski[62] and Murphy[45]) had hematemesis, although one (Murphy) might have been attributed to an associated duodenal ulcer. As Ravdin[53] has observed, the nearer the ulcer to the duodenum, the closer the pain relation to food and alkali, although the actual time intervals are as variable as those one sometimes sees in cases of duodenal ulcer. Melæna may occur in this ulceration as in any other.

Acute, sudden, and severe abdominal pain coupled with the fulminating symptoms of peritonitis (distension, vomiting, and obstipation) as well as the signs of peritonitis (silent, tender, board-rigid abdomen) should lead one to a diagnosis of a perforated ulcer. While there may be no previous ulcer history, the symptoms and signs are characteristic. The perforation will be more commonly in the duodenum or stomach, although localization of pain, initial or late, in the lower abdomen may lead one to suspect the jejunum. In the exploration of the abdomen for such a perforative catastrophe, and in the presence of this fulminating or chemical peritonitis, the jejunum, and particularly its first portion, should not be overlooked when nothing is found in the stomach or duodenum.

The diminution or absence of liver dullness due to the presence of air over the diaphragm, while difficult to elicit, may support the diagnosis of a perforated ulcer.

Laboratory Findings.—Few of the reported cases included blood counts. One or two, in the presence of peritonitis following perforation, had a blood count between 18,400 and 20,000 white blood corpuscles per cubic millimetre.

The fractional gastric analyses have tended to show a low or absent free hydrochloric acid by the fractional gastric test meal. The case reported had

no free hydrochloric acid by the test meal. The cases of Schmilinski,[62] Walton,[74] and Smith[67] were similar. Ravdin's[53] case, on the contrary, had a satisfactory curve for both the free and total acid determinations.

Röntgenological Findings.—Gastro-intestinal studies would appear to be extremely valuable. In the reported case, the ulcer was definitely localized in the jejunum, and, still further, to about six inches beyond the duodeno-jejunal flexure. This means of investigation was employed in all of the non-perforating ulcers. Only one other study (Ravdin[53]) showed the location of the ulcer. It was only recognized after one exploratory operation had been performed. A review of the films made before the first operation showed the defect.

All one could except from the röntgenological examination would be a regurgitation of the opaque medium (fluoroscopical) into the bowel proximal to the ulcer, actual distension of the proximal loops in the presence of obstruction, and demonstration of a narrow constricted lumen at the site of stenosis. Schmilinski's[62] and Murphy's[45] cases had obstructive incompetence of the stomach and duodenum. Smith's[67] case presented ulcer symptoms and was examined four months prior to the time his ulcer perforated. The gastro-intestinal series showed only spasticity in the abdomen.

There is no anatomical reason why the X-ray (fluoroscope) would not be extremely valuable as an aid in the diagnosis of perforation. Its use has been clearly demonstrated in the determination of air under the diaphragm in the presence of perforation of duodenal and gastric ulcers. Although the jejunum is retro-omental, air, with the patient in the upright position, will find its way to the domes of the diaphragm. This means of demonstrating perforation is extremely valuable. When air is observed, the diagnosis of perforation is definite. This method for the demonstration of escaped air is more accurate than the determination of an altered liver dullness since one cannot know just what size the patient's liver was before observation and onset of symptoms.

In eighteen of the perforated ulcers which came to operation, the pre-operative diagnosis was recorded in fourteen. In seven of these a diagnosis of a perforated gastric or duodenal ulcer was made. In three a diagnosis of appendicitis was offered; in one, intestinal obstruction, and in the remaining three, an unexplained peritonitis. In the seven non-perforated ulcers, a correct diagnosis was recorded but in one case, the reported one. The other six were variously diagnosed as duodenal ulcer, intestinal obstruction, while in two cases diagnosis was uncertain.

Treatment.—The perforated ulcer demands immediate surgery. The possibilities of medical treatment in the chronic ulcer which makes itself manifest by pain or obstruction are practically nil, although, from autopsy reports, it would appear that some people can go many years without being aware of this disease.

In the group without perforation, resection of the ulcer-bearing portion of the jejunum was the operation of choice. Because of the possibility of

malignancy, and especially in the presence of enlarged mesenteric glands, resection is imperative.

In the group with perforation, the ulcer was found and directly attacked in seventeen cases. In ten of these, the area of the ulcer was merely oversewed and the abdominal cavity drained. Six patients survived. In two, the area was oversewed and a posterior gastroenterostomy performed. One lived. In five, resection and lateral anastomosis were performed. Four survived. With but two exceptions, drainage of the abdominal cavity was carried out in the last two groups. In that group in which resection was done, the four patients that survived had all been operated on within twenty-four hours.

Mortality Statistics.—Twenty-five of the forty-two collected cases succumbed, giving a total mortality of 59.5 per cent. Death occurred in only one case in which the ulcer had not perforated. There were thirty-five cases of perforated ulcer, 83.3 per cent. of the total collected cases. Apparently perforation occurs relatively more frequently in the jejunal ulcer than in gastric, duodenal, or gastrojejunal ulcers. Of 368 duodenal ulcers observed in the surgical department of the University Hospital from 1921 to 1932, only forty-eight were perforated, 13.1 per cent. Wright,[76] reporting 135 secondary jejunal or gastrojejunal ulcers, observed perforation in thirty-one, 22.9 per cent. Bolton and Trotter[6] reported that 10 per cent. of these ulcerations perforated into the big gut. For anatomical reasons this does not occur with the primary jejunal ulcer.

Twenty-four of the patients with perforated ulcers died, giving a total mortality for this group of 68.5 per cent. This is strikingly high when compared with the total mortality of the above-mentioned series of perforated duodenal ulcers, 25 per cent. In the group with perforation, eighteen (52.8 per cent.) were operated upon, the ulcer discovered, and one of the reparative procedures carried out. Seven of this group died, giving an operative mortality of 38.8 per cent. If those cases were included in which, because of wrong diagnosis, needless operative procedures were carried out, and the one in which the site of perforation was not found, the operative mortality of the cases with perforated ulcers would be higher. The figure for the operative mortality in the perforated duodenal ulcer group was 23.9 per cent.

As in the surgery of the perforated gastric or duodenal ulcer, the earlier operative intervention is instituted, the lower the mortality in these cases of perforated jejunal ulcers. While two of those patients survived whose perforated ulcers were operated upon within forty-eight hours, the remaining nine were operated upon within twenty-four hours.

ADDITIONAL CASES OF PRIMARY JEJUNAL ULCERATION NOTED AT AUTOPSY OR OPERATION FOR SOME OTHER COMPLAINT. NO HISTORY

Mayo Clinic,[37] nine cases (unconfirmed).
Schoo,[63] one case at autopsy.
Schoo,[63] one case at autopsy.
Murphy,[45] one case at operating table.
Askanazy,[2] one case pathological report.
Rotgans,[59] one case during operation for gastric ulcer.

SUMMMARY AND CONCLUSIONS.—(1) Primary jejunal ulceration is a disease of rare occurrence whose clinical importance and significance depends upon a relatively high total mortality.

(2) The recognition of simple ulceration of the jejunum depends upon the history of dyspepsia and gastric distress with symptoms not unlike those of peptic duodenal ulcer and, occasionally, of subacute upper jejunal obstruction.

(3) The location of the ulceration may be determined by serial X-ray studies of the gastro-intestinal tract.

(4) The majority of primary jejunal ulcers manifest themselves by acute perforation.

(5) The diagnosis of perforated ulcer of the jejunum may be made from the history of a sudden onset of pain with fulminating signs and symptoms of peritonitis, whether or not there was a previous ulcer history.

(6) The use of the X-ray (fluoroscope) is recommended for its value in the demonstration of air under the dome of the diaphragm in the presence of a perforated jejunal ulcer as it is for a similar perforation of a duodenal or gastric ulcer.

(7) The earlier the surgery in the presence of perforation, the lower the mortality. Pain or obstructive symptoms with localization of the lesion to the jejunum should be treated surgically.

(8) Resection, when possible, is the operation of choice, and most imperative when mesenteric nodes are enlarged.

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THE RESULTS OF MEDICAL AND SURGICAL TREATMENT OF PEPTIC ULCER *

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The purpose of this study is to evaluate the results obtained with the medical and surgical treatment of peptic ulcer. Although the number of cases studied is comparatively small (fifty-two medical cases and fifty-two surgical cases), nevertheless, this series has particular value because of the length of time that these cases have been under observation and because of the thoroughness of the follow-up study. Each patient was personally interviewed and fluoroscoped by the authors; radiographs were also made and interpreted by Dr. John R. Carty, Chief of the X-ray Department of Cornell Clinic.

The medical treatment employed has been ambulatory, consisting of a modified Sippy diet with olive oil before meals and milk and crackers between meals. One-half to one dram of alkaline powder (equal parts of magnesium carbonate, sodium bicarbonate and bismuth subcarbonate) is taken one hour after meals. In some cases tincture of belladonna, and sedatives such as bromides and phenobarbital, are used. At the start of the treatment the patient is encouraged to report every week or two; the diet is discussed thoroughly; the importance of regulating his mode of living is emphasized and the teeth, tonsils and sinuses are treated when indicated. Thereafter, the patient reports once in three months, adhering to the strict diet from three to six months; after this, the diet is increased, allowing a choice of meats and coarser fruits and vegetables. The milk between meals is continued indefinitely. The alkalinization is gradually reduced after three to six months. The patient is fluoroscoped and radiographed every six months.

The immediate response to this form of treatment is very gratifying. In a week or two, the vast majority of patients become free of pain, enthusiastic about the diet and believe a cure is in store for them. However, in judging the results of any form of ulcer treatment, the time element is of utmost importance. The first year or two give very good results, but the third, fourth and fifth years show an increasing number of recurrences. In this series the length of time the cases were studied is as follows:

Although the medical cases have been followed for a longer period of time, it will be noted in Table I that 88.5 per cent. of the surgical cases have been studied over four years and we believe that a fairly accurate comparison of the results can be made between the two groups.

* Read before a combined meeting of the Section of Surgery, New York Academy of Medicine, and the New York Gastro-enterological Association, April 1, 1932.

TABLE I

Length of Time under Observation	Medical		Surgical	
	No. of Cases	Per Cent	No. of Cases	Per Cent.
3–4 years	0		6	11.5%
4–5 years	0		12	23%
5–6 years	24	46%	18	34.5%
6–7 years	14	27%	11	21%
Over 7 years	14	27%	5	10%
Shortest time	5 years		3 years	
Longest time	9 years		9.25 years	
Average time	6 years		5.3 years	

The response to the request to return for examination was elicited in 13 per cent. of the medical cases and in 75 per cent. of the surgical cases. This bears out the experience of others and in the words of Emery and Monroe, who have put it very aptly: "The patient with ulcer is notoriously of a wandering disposition. He goes from one physician to another in search of a cure. A return of symptoms leads him to consult some one else, who may understand his case better. The new advice is often different from the old, and is again accompanied by the assumption that rigid adherence to the new régime will be followed by permanent results. This causes an unsatisfactory state of affairs. The physician is led to believe that his treatment has been efficacious, since the patient does not return. The patient loses confidence."

The average length of time that the medical cases were treated at the Clinic before they discontinued the treatment was two and one-half years; the shortest period one month; the longest six and one-half years; thirty-two cases were treated under two years. These figures show the difficulty in following these patients. They usually discontinue treatment at the end of two years believing that they are cured.

In the surgical group the average duration of medical treatment before operation was 6.5 months. The longest period of treatment before operation was thirty months. Nineteen cases received no medical treatment but were operated on immediately for indications such as obstruction of the pylorus, perforation or penetration.

TABLE II

Age of Patients on Admission

	Medical	Surgical
10–20 years	0	1
20–30 years	15	7
30–40 years	15	23
40–50 years	16	17
50–60 years	6	5
Youngest	23 years	17 years
Oldest	59 years	57 years
Average age	37.5 years	37.7 years

It will be noted that the average age in both groups is practically the same and agrees with the statistics of others; also, that the majority of ulcers occurred in middle life, between the ages of thirty and fifty.

Sex.—In this series there were eighty-three males and twenty-one females, bearing out the well-known fact that the disease is much more common in the male.

Duration of Symptoms at the Time of Admission

	Medical	Surgical
Shortest duration	10 days	30 days
Longest duration	27 years	34 years
Average duration	5 years	5.8 years

Both groups show practically the same average of duration which again emphasizes the chronicity of this disease.

TABLE III

Types of Ulcer

	Medical	Surgical
Post-pyloric	43	45
Parapyloric	5	0
Pyloric	1	0
Gastric	3	6
Post-pyloric and gastric	0	1

The duodenal ulcers predominate, there being 88 per cent. as against 9.6 per cent. of gastric ulcers. These figures correspond to the findings in the entire ulcer group at the Cornell Clinic.

TABLE IV

Symptomatology

Symptoms	Medical	Surgical
Pain in the epigastrium	49	47
Pain in the right upper quadrant	0	2
Pain in the left upper quadrant	3	2
Pain in the lower abdomen	0	1
Awakened at night with pain	30	22
Vomiting	10	31
Hematemesis	2	9
Pain relieved by food and alkalies	52	51
Periodicity	52	52

In analyzing the above symptoms, we note that all the patients except one complained of pain in the upper abdomen, and in 92.3 per cent., the pain was located in the epigastrium. Also that in all the cases except one, relief was obtained with food and alkalies. Periodicity was present in all of the cases.

We believe that this triad of upper abdominal pain relieved by food and alkalies with periods of remission from symptoms is the important diagnostic sign of peptic ulcer. In all our cases there was either positive X-ray or surgical pathological evidence of ulcer.

TABLE V

Previous Abdominal Operations

	Medical	Surgical
Chronic appendicitis	2	6
Acute appendicitis	0	4
Perforation of ulcer (one case perforated twice)	1	2
Excision of ulcer	0	1
Kidney stone	1	0
Cholecystectomy, appendectomy and exploratory gastrotomy	0	1

It is a striking fact that 20 per cent. of the cases in this series have had operations previous to admission and after the onset of their ulcer symptoms and that of these, seven had had laparotomies without discovery of the real cause of their symptoms.

TABLE VI

Indications for Operation

	Post-pyloric Ulcer	Gastric Ulcer	Post-pyloric and Gastric Ulcers
Obstruction	9	2	
Persistent symptoms	29		
Unknown	5		
Perforation	3		
Penetration		3	1
Bleeding	1		
Suspected malignancy		1	

It will be noted that in twenty-nine of the surgical cases (55.7 per cent.) the indication for operation was the persistence of symptoms. We have found that the medical régime of ulcer with its frequent feedings and frequent medication cannot be adhered to by a certain class of patients such as the mechanic, clerk or laborer. Surgery surely offers these people a greater measure of relief and is economically more practical. This will be shown later by our results.

TABLE VII

Types of Operation

	Post-pyloric Ulcer	Gastric Ulcer	Post-pyloric and Gastric Ulcer
Gastroenterostomy	32	1	
Polya	5	4	
Billroth, No. 2	3	1	
Gastroenterostomy and resection of ulcer	1		
Simple suture	2		
Plastic	1		
Resection of gastric ulcer and plastic on pylorus			1
Gastroenterostomy and cautery	1		
Horsley	1		

The preponderance of gastroenterostomy in this series is due to the fact that most of the ulcers were post-pyloric and it is our opinion as well

as that of most conservative surgeons that this is the operation of choice in this condition. In a previous communication (Hartwell and Felter) it was shown that these cases were operated upon by a large number of different surgeons at many different clinics, that the mortality in this group of cases was only 2 to 3 per cent. and that the results were extremely satisfactory.

TABLE VIII

Results of Treatment

	Medical		Surgical	
	No. of Cases	Per Cent.	No. of Cases	Per Cent.
Satisfactory	10	19	42	80
Improved	8	15	5	10
Unsatisfactory	34	66	5	10

The results have been placed in three categories:

(1) *Satisfactory.*—In this category we placed patients who have been free from pain for three years or longer, who are eating everything and have no digestive disturbances. In this group there were ten medical cases, two of which were gastric ulcers and eight post-pyloric ulcers. The average freedom from symptoms was 4.2 years. The X-ray findings in these cases showed the two gastric ulcers to be completely healed and one of the post-pyloric ulcers failed to show a filling defect. The rest of the cases showed filling defects of the duodenal cap.

In the surgical group that proved satisfactory there were thirty-five duodenal ulcers, six gastric ulcers and one gastroduodenal ulcer.

(2) *Improved Cases.*—Under this heading we have placed those cases which are not complaining of pain but still have digestive disturbances and are compelled to follow a strict ulcer régime with alkalies.

In this group there were eight medical cases. One had a return of symptoms in four and one-half years, another had a severe hæmorrhage after four years of freedom from symptoms.

In the surgical group there are five cases considered as improved. Although these patients do not complain of the pain previous to operation, still they have more or less digestive disturbance and are compelled to follow strict diets.

(3) *Unsatisfactory Cases.*—In this group are placed the patients who have not improved or in whom the symptoms have become worse.

In the medical series, there are thirty-four cases. They are still having pain at frequent intervals. Radiographically, the lesions appear either the same or have increased in size. A certain number have developed adhesions. Some of the ulcers which formerly were confined to the duodenum only are now involving the pyloric and pre-pyloric regions. There was one case of gastric ulcer which returned after a five-year period of freedom from symptoms. There were five cases of duodenal ulcer in which symptoms returned five years later. There were two cases which showed the importance of the radiographical examination in the follow-up study of ulcer.

At the initial examination they both revealed a pyloric ulcer with a twenty-four-hour retention of barium; they refused surgical treatment at that time. They returned five years later claiming to be free from symptoms and eating everything but the recent radiographical examinations reveal the same pyloric lesion with a twenty-four-hour gastric retention.

In this group there were also three cases that were operated upon subsequent to our initial examination; the surgeon thought that the ulcer was healed and nothing more was done to relieve the ulcer. These three patients still have the same symptoms and the same ulcer is seen radiographically.

In the surgical group there were five unsatisfactory cases. One of these developed a gastric ulcer after having been free of symptoms for four and one-half years after gastroenterostomy for duodenal ulcer. Two cases had recurrence of severe hæmorrhage following operation. One case which had had a duodenal ulcer excised was still having recurrent attacks of severe pain seven years after operation. Another case was having all her old symptoms five years after a subtotal resection for duodenal ulcer, although there was no evidence of ulcer on the radiographical examination.

Comment.—From the study of the foregoing figures, the conclusion can be reached that the ambulatory treatment is a poor method of treating ulcer. The question might then be raised whether or not other forms of medical treatment would offer better results. Our personal experience with other forms of treatment has been limited but the medical literature contains valuable records of comparison. Blackford and Bowers reported on twenty cases receiving the Sippy hospital treatment with 60 per cent. satisfactory results and sixty cases receiving ambulatory treatment with 58 per cent. satisfactory results.[5] They concluded, however, as follows: "Hospital treatment almost always brought immediate relief; but as time elapsed we found that many patients had a return of trouble, in spite of every care and advice that we could give them regarding diet and medication. We were forced to the opinion that it was doubtful whether these favorable cases (with three or four weeks in the hospital behind them and a year or more of extreme care afterward) did better than those on casual ambulatory treatment."

Einhorn and Crohn in 1926 reported on 100 cases which had received the hospital treatment on a modified Sippy régime. On a follow-up of twenty-two cases for four years, they report a cure in only 27.3 per cent.

Although there is a variation in the results reported by many observers, nevertheless the majority report poor results with all forms of medical treatment of ulcer, depending largely on the length of time elapsed that the cases are followed. This is excellently summarized by Einhorn and Crohn as follows: "Thus, Friedenwald, after five years of follow-up survey, reports 74 per cent. of 'cured or improved,' Greenough and Joslin only 52 per cent. for a similar group and period. After two to thirteen years of follow-up, Russell reported 27.7 per cent. cured and 15 per cent. improved, and after a ten-year follow-up, Delmasure could find only 14 per cent. cured and 23 per cent. improved. These figures from the literature

are surprising and far from reassuring for the ultimate outcome of medical treatment of ulcer of the stomach or duodenum.

As is well known, there is considerable controversy as to the relative merit of medical and surgical treatment of ulcer. In order to arrive at some definite conclusions on this subject, we have attempted the above study emphasizing the importance of a personal follow-up over a long period of time including comparative radiographical studies. We feel that a questionnaire follow-up in the above series would have led us to erroneous conclusions. Many of the surgical cases have been seen and X-rayed from two to four times after operation, and at least once previous to surgical treatment. The medical cases have received between two to six radiographical examinations.

The results of surgical treatment are all the more striking when it is considered that this group must of necessity have had more severe symptoms than the medically treated cases. At the Cornell Clinic a conservative attitude is adopted toward ulcer patients. Every effort is made to avoid surgical treatment; many cases are hospitalized and receive the Sippy treatment before surgery is finally resorted to. No case is operated upon unless there has been a joint consultation between the gastroenterologist, surgeon and radiologist.

Conclusions.—(1) One hundred and four cases of peptic ulcer were followed on an average of 5.6 years, fifty-two treated medically and fifty-two treated surgically.

(2) Of the cases treated medically, 19 per cent. were satisfactory. Of the surgically treated cases, 80 per cent. were satisfactory.

(3) Of the medically treated cases, 15 per cent. more were improved. Of the surgically treated cases, 10 per cent. more were improved.

(4) The results were unsatisfactory in 66 per cent. of the medically treated cases and 10 per cent. were unsatisfactory in the surgically treated group.

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CLINICAL AND PATHOLOGICAL FACTORS INFLUENCING ULTIMATE PROGNOSIS FOLLOWING RESECTION FOR CARCINOMA OF THE STOMACH

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from the mayo clinic *

Because of refinements in diagnostic procedures and because the span of life is increasing, a relative increase in the incidence of malignant lesions has been noted. To the lay mind this has signified an increase in the incidence of carcinoma and has contributed to the uneasiness already existent. The impression has been disseminated that any recognized therapeutic measure is utterly futile, and on this information rests the financial success of the innumerable "cancer cures," the majority of which are based on the local application of a paste or other substance. In event the malignant process is confined to an internal organ where the beneficial effects of the external application might be doubted, an increased feeling of hopelessness is produced. This is the state of mind in which the victim of a malignant process of the stomach finds himself. The futility of orthodox treatment has been impressed on him by the ultraconservative prognosticator and he has despaired of more than palliation. The facts show, however, that in a large group of cases excellent results have followed surgical removal of malignant lesions of the stomach. Infrequently, the surgical procedure was supposedly undertaken for palliation only, and the patient has lived in good health for ten years or more.

My purpose in presenting these data is twofold: First, to place on record the more favorable aspect of surgery of the stomach for malignant lesions; 273 cases are considered in which resection of the stomach was done in The Mayo Clinic for carcinoma and the patients lived five years or longer. This group has been divided into two subgroups: (1) 145 patients who when last heard from had lived between five and ten years (62 per cent. of these were still living), and (2) 128 patients who had lived ten years or longer. Second, to consider in detail the clinical and pathological factors that might have some bearing on the ultimate outcome in similar conditions. To evaluate properly such data as might exist, a third group of 100 cases was selected in which resection of the stomach had been done at The Mayo Clinic for carcinoma, and the patients had died from the malignant process within twelve months. Those who had died from other causes were excluded. The results of this study are presented.

Method of Study.—In the 373 cases which comprised the three groups, the specimens were removed between January 1, 1907, and December 31,

* Abridgement of thesis submitted to the faculty of the Graduate School of the University of Minnesota. Submitted for publication August 17, 1932.

1924. With the exception of a few unusually interesting specimens that had been mounted for museum exhibit, the material had been preserved in formalin solution; other material had been cut so extensively by previous investigators that further study was impossible. Such omissions have been noted. Each specimen was subjected to gross examination, its situation, size, and general characteristics were noted, and a block was cut from the body of the tumor for microscopical study and grading. The frozen and paraffin sections were stained in the usual manner with hematoxylin and eosin. The presence or absence of lymphatic involvement had been determined previously by the pathologist, who received the fresh specimen from the operating room, and it was necessary to accept this report without further study, owing to the futility of obtaining accurate information concerning specimens that had been preserved for so long a time.

The clinical data were obtained by personal study of all records and data as supplied by the record department of the clinic.

All specimens were graded prior to personal supervision and correction by Broders, and the classification of grades was made according to his method. The cases have been divided for study into three groups: group 1, cases in which patients died within twelve months after operation (100 cases); group 2, cases in which the patients lived five years or longer after operation (145 cases) and group 3, cases in which the patients lived ten years or longer (128 cases).

The ratio of men to women (3:1) followed quite closely that noted by other observers. There was a slight increase in incidence among women of group 1.

It is commonly believed that virulence of a malignant process, all other factors being equal, varies in inverse proportion to the age of the patient. Although the difference in the average age of those who survived ten years (groups 2 and 3) and those who died within twelve months (group 1) was only one and nine-tenths years, the patients in groups 2 and 3 were younger. Because of the qualifying statement, "all other factors being equal," no exception could be made in this case with regard to the virulence of the malignant process noted in the cases in question. It was noted that the percentage incidence by decades showed remarkable consistence in the three groups, and that no reliable prognostic criteria could be deduced from this source. (Fig. 1.)

Contrary to what might be expected, a lower percentage of family histories of malignancy occurred among the patients of group 1 than in either group 2 or group 3.

The clinical histories in the 373 cases revealed that three distinct clinical entities can be recognized easily. In most of the cases (approximately 75 per cent.) symptoms had persisted without remarkable change except gradual increase in severity for a varying length of time. Not infrequently a rather typical ulcer syndrome was described, but more often the distress consisted of vague and bizarre digestive distress as Eusterman and others have em-

phasized. Such symptoms had persisted for from less than three months to twenty-five years, but in most cases they had not been present prior to a year before the patient was operated on. In another series of cases (approximately 25 per cent.) symptoms had been referable to the stomach for varying lengths of time, but a recent change or additional symptom other than a slight gradual increase in severity had been noted. It was because of this change that the patients sought relief. A negligible percentage of patients comprising the third series had not experienced symptoms suggesting a gastric lesion, and the carcinoma of the stomach was found accidentally.

An attempt was made to determine in an impartial manner the length of time during which the malignant process had made itself manifest. It seemed logical to assume that the process would be rather consistent for all patients irrespective of group (as determined arbitrarily by the length of

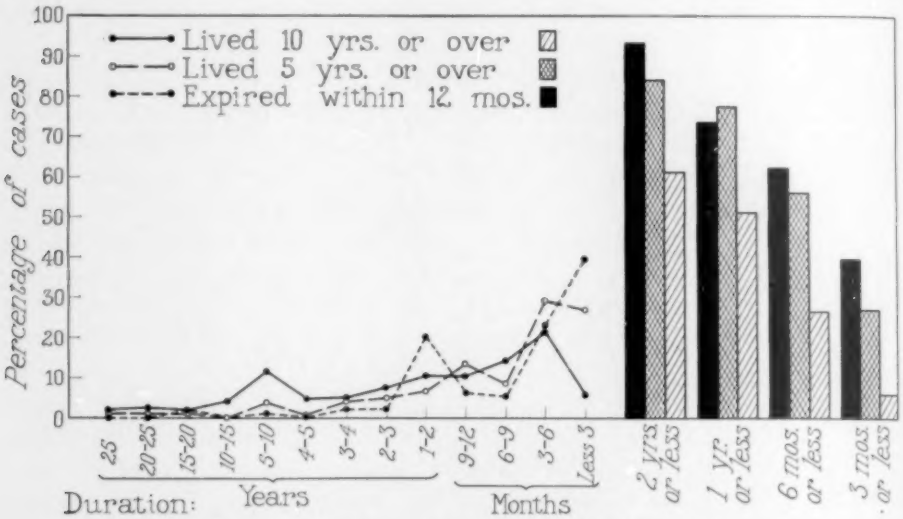

FIG. 1.—Percentage of cases by groups in relation to the duration of symptoms.

post-operative life), and that all would endure an equal amount of distress before seeking medical attention. The most accurate estimate that could be obtained, therefore, consisted in evaluation of the length of time the patients had had symptoms for which they sought relief. (Fig. 1.) Consistently, the patients who lived for a considerable number of years after resection of the malignant process had had symptoms longer than those who died within twelve months. Two explanations for this are possible: either the process was progressing more rapidly, or because of some unknown peculiarity it had progressed so far silently that when symptoms finally occurred cure was no longer possible.

The average loss of weight in the three groups varied only by 0.4 pounds. The general condition of the patient, as evidenced by this factor, was much the same in all groups, but it may be noted that the patients who died within a year had had symptoms which averaged a shorter duration.

The average percentage value of the hæmoglobin prior to resection was 9.8 points higher in group 1 than in groups 2 and 3. The chronic character of the lesions must have played a part in this determination.

The percentage incidence of cases relative to gastric retention was charted. Uniform amounts of retention were recorded and the curve showed remarkable consistence.

Hartman and Sager* have shown that anacidity prior to resection is associated with twice the chance of five years' post-operative life than if free hydrochloric acid could be demonstrated. In the cases under consideration anacidity was present in 68.8 per cent. of patients who died a year after operation (group 1). In 49.5 and 47.5 per cent. of patients who lived more than five and ten years, respectively (groups 2 and 3), it was impossible to demonstrate free acidity.

In all groups most of the lesions occurred in the antrum, although they were observed approximately one-fifth more often in this locality in cases of group 1 than in cases of groups 2 and 3. Conversely, a malignant process on the lesser curvature of the stomach was twice as common in groups 2 and 3, whereas malignant tumors on the anterior wall, posterior wall, and greater curvature were almost equally common.

The average size of the lesion was determined, not by the size relative to situation, but by comparing the average size of the lesion in the three groups. The tumor with the most discouraging prognosis was the smallest in the three groups.

The sessile type of tumor with a broad flat base which projected into the lumen of the stomach occurred with almost equal incidence in all groups. Evidence that perforation is of grave prognostic significance is shown by the fact that this had taken place seven to eight times as often in group 1 as in groups 2 and 3. Ulceration, on the other hand, was seen in only 8 per cent. of the cases in group 1 as compared with 37.9 and 35.9 per cent. in groups 2 and 3. (Fig. 2.)

As was to be expected, lymphatic involvement occurred more frequently in the group in which death occurred early. It was noted in from 41.7 to 49.3 per cent. more cases in group 1 than in groups 2 and 3. (Fig. 3.) Such involvement relative to the site of the lesion was of minor significance.

Little can be added with regard to involvement of the serosa to what has been noted regarding involvement of the lymph-nodes. Involvement of the serosa was of grave prognostic significance, as it was observed 46.4 per cent. more often in cases of group 1 than in those of group 2, and 65.9 per cent. more often in cases of group 3. (Fig. 4.)

Carcinoma of the stomach, graded 1, is relatively uncommon. The high incidence of recurrence following resection of malignant gastric lesions in general can be attributed to this fact. The greatest incidence of the lowest grade of malignancy occurred in cases of group 3. The incidence in these

* Hartman, H. R., and Sager, W. W.: A Statistical Study of the Diagnostic Value of Anacidity. Med. Jour. and Rec., vol. cxxiv, pp. 96-97, July 21, 1926.

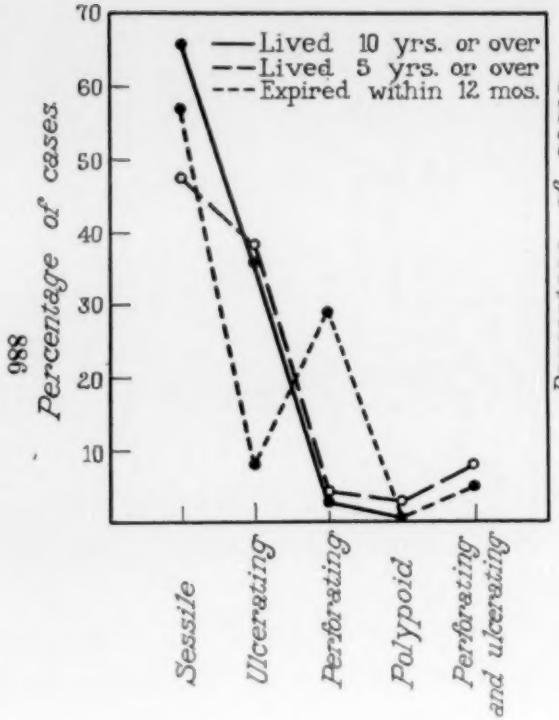

FIG. 2.—Percentage of cases by groups in relation to type of lesion.

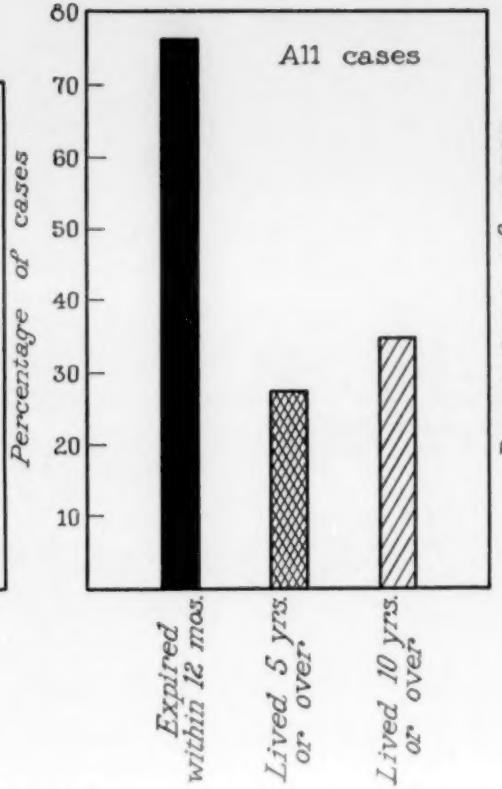

FIG. 3.—Percentage of cases by groups with lymphatic involvement.

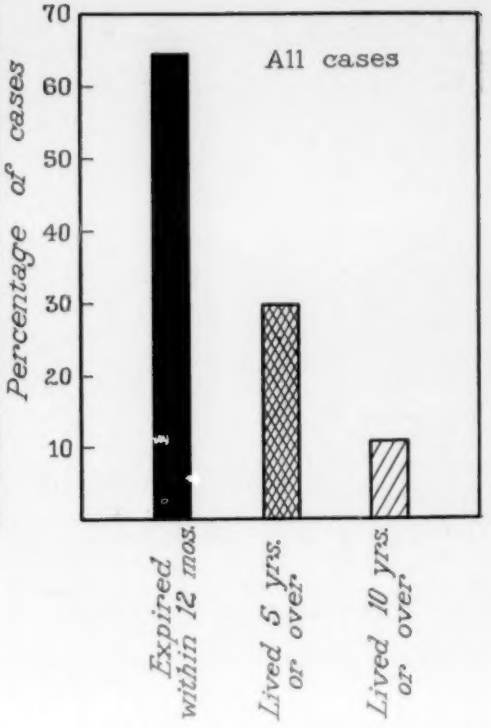

FIG. 4.—Percentage of cases by groups with involvement of the serosa.

cases increased in direct proportion to the length of post-operative life. This was also true in cases of malignancy, graded 2, which comprised only 8.2 per cent. of the cases in group 1. Seventy-one and four-tenths per cent. of the patients in group 1 had involved regional lymph-nodes as compared with 35.4 and 40.0 per cent. in groups 2 and 3. Lesions graded 3 and 4 exhibited exactly the opposite phenomenon; the incidence decreased in direct proportion to the length of post-operative life. (Fig. 5.) Involvement of the lymph-nodes occurred in 72.7 and 84.4 per cent. in cases of group 1, 26 and 25 per cent. in cases of group 2 and 44 and 66 per cent. in cases of group 3, in the same grades. In other words, involvement of the lymph-nodes occurred less frequently in the higher grades of malignancy in cases in which patients lived five years or more after operation than it did in cases in which patients were unable to withstand the process longer than one year.

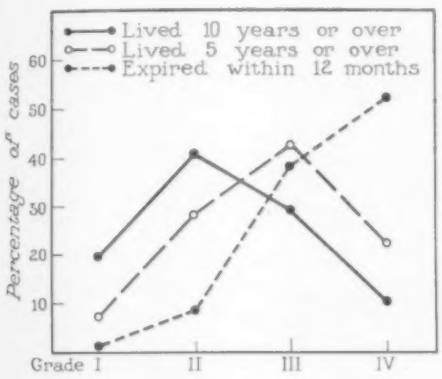

Fig. 5.

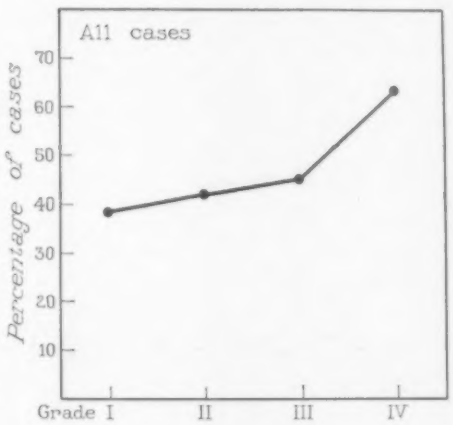

Fig. 6.

Fig. 5.—Percentage of cases by groups in relation to the grade of the lesion.
Fig. 6.—Percentage of all cases with lymphatic involvement in relation to the grade of the lesion.

Summary and Conclusions.—Three hundred seventy-three cases in which resection of the stomach had been done for carcinoma at The Mayo Clinic were studied. The cases were divided into three groups: (1) 100 cases, in which patients did not survive longer than twelve months after operation; (2) 145 cases, in which the patients had lived more than five years when last heard from, and (3) 128 cases, in which patients had lived longer than ten years after operation.

The groups were studied as separate entities in an effort to determine the clinical and pathological factors that might influence the ultimate prognosis. The pathological data, with the exception of grading of malignancy, was based on the total number of cases. Due to the fact that ninety-two specimens had been preserved permanently for museum exhibition, or had been cut previously to such an extent that further study was impossible, blocks for microscopical examination and grading were obtained in 281 cases.

An analysis of results suggests certain positive and negative conclusions

relative to the clinical and pathological factors that influence the ultimate prognosis following resection of the stomach for carcinoma.

From a clinical standpoint, sex, age, familial history of malignancy, and attempts to determine the general condition of the patient as evidenced by loss of weight and measurements of the total quantity of gastric content are inconclusive so far as prognosis is concerned.

Features of positive clinical prognostic significance depend, first, on a careful determination of the duration of symptoms. A short history of a gastric lesion in the age group included in this study is a grave prognostic omen, since it suggests a rapidly progressing process. This impression is strengthened by the fact that the average hæmoglobin value was seen to be higher in these cases than in those in which a relatively chronic disease was in progress. The presence of anacidity must be considered with some apprehension.

From a pathological standpoint no prognostic factors can be elicited from the situation of the lesion, with the obvious exception that resection is technically possible with average operative risk.

The fact that the average size of the lesions in the group in which prognosis is less favorable (group 1) was smaller than the groups in which post-operative life was more than five years (groups 2 and 3) is further evidence to support the fact that the disease has been present for a shorter period. An ulcerating growth tends to render the prognosis less grave, whereas a perforating growth adds to the seriousness of the situation.

The three most important factors that decrease the possibility of a long post-operative life are involvement of the lymph-nodes and the serosa, and a tumor of high-grade malignancy. Because the incidence of involvement of the lymph-nodes increased in direct proportion to the increase in severity of the malignant process as indicated by the grade, the last-named feature should be considered the most important single factor.

INFLAMMATORY TUMORS OF THE GASTRO-INTESTINAL TRACT

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From the Fourth Surgical Division Bellevue Hospital

The significance of simple inflammatory tumors of the gastro-intestinal tract seems to have been first pointed out by Moynihan,[1] in 1907, when, in an article entitled Mimicry of Malignant Disease in the Large Intestine, he stated that during the course of the three preceding years he had operated upon six tumors of the large intestine under the mistaken impression that he was dealing with examples of malignant disease. In all these cases, the clinical manifestations and macroscopical appearances supported this opinion but minute examination of specimens removed or the subsequent history of the case proved that the disease was in every instance of non-malignant character. In 1908, Robson[2] discussing Some Abdominal Tumors Simulating Malignant Disease expressed the opinion that the simple inflammatory tumor of the intestine was relatively common, that it presented one of the most difficult problems in abdominal diagnosis and, in confirmation of both contentions, cited numerous illustrative cases from his records. About the same time Proust,[3] in France, and Braun,[4] in Germany, contributed similar experiences. The former resected the transverse colon for a tumor whose pre-operative diagnosis was carcinoma or tuberculosis while the latter removed from the sigmoid a mass which he believed to be a carcinoma. In each instance these original diagnoses were supported by the classical symptoms of large-gut malignancy, *viz.*: loss of weight, bleeding, colic, obstruction and operative exposure of the pathology merely disclosed gross evidence confirming this conception. Upon further study of the specimens, however, it was noted that both exhibited features which clearly differentiated them from the carcinomata. In the first place, it was apparent macroscopically that instead of originating in the mucosa as do the carcinomata, these masses appeared to have their inception in the mesocolon whence they had invaded the gut walls secondarily. Microscopically, the tumors were made up largely of poorly nucleated connective tissue with new blood-vessel formation, perivascular round-cell infiltration and many leucocytes. The mucosa was well preserved and there was no histological proof of malignancy, necrosis or abscess formation. Both these observers regarded this tumor as a definite disease entity which in the absence of careful histological analysis would usually be mistaken for carcinoma whose gross and clinical aspects it so accurately simulated. They therefore attempted to identify this structure by the adoption of an appropriate terminology "Pseudo-tumor" (Braun) and "Paraintestinal Tumor" (Proust).

The publication of the foregoing reports awakened a new interest in the routine analysis of large-gut tumors with the result that, during the subse-

quent few years, an increasing number of these cases appeared in the literature of England and on the Continent. In our own country, however, recognition of this type of tumor has not been general and, with few exceptions, our literature and texts have completely ignored this subject. Notable among these exceptions are the publications of Moscowitz and Wilensky,[5] in 1923, and Mock,[6] in 1931.

The former gathered from various hospitals of New York City four interesting examples of this condition for which they proposed the term "Non-specific Granuloma of the Intestine." In all four cases there was a dense uncircumscribed mass involving all coats of the large intestine causing stricture of the lumen. In three cases the ascending colon was involved and, in the fourth, the splenic flexure. In one case the main bulk of the tumor projected into the mesentery whereas in the remaining three the infiltrating process was most prominent in the gut wall. Superficial ulcerations were noted in the mucosa but in general this layer was intact and fairly well preserved.

In all these specimens a fairly uniform microscopical morphology was revealed. All coats of the intestine were densely infiltrated by a fibroblastic process which varied from a cellular and apparently fresh granulation tissue with many newly formed blood spaces to a comparatively dense fibrous structure. This tissue appeared in the submucosa but infiltrated the muscle to such an extent as to cause extensive distortion and separation. The round cell was predominant throughout. In one case numerous giant cells were found and, in another, an area of polymorphonuclear infiltration justified the term "abscess."

Of the ten cases reported by Mock, three involved the omentum, three the stomach, one the ileum and three the large-gut-cæcum, splenic flexure, sigmoid. In all except the omental tumors, gross inspection at operation led to the definite diagnosis of neoplasm and frozen sections made at this time on the splenic flexure and the cecal tumors were respectively reported as round-cell sarcoma and carcinoma. In all these cases further histological study disclosed the familiar picture of chronic inflammation and the subsequent clinical course eventually confirmed the diagnosis. To designate this type of tumor this writer proposed the term "Infective Granuloma" as appropriately expressive of the character of the process and assembled a convincing array of histological opinion in support of this usage.

These facts open up interesting possibilities for the consideration of both pathologist and clinician. The histological picture encountered in this condition is frequently perplexing when its gross characteristics are borne in mind and occasionally leads to erroneous pathological diagnoses. In two of Mock's cases, frozen section was responsible for classifications of sarcoma and carcinoma while specimens exhibiting giant cells have been grouped under tuberculosis. Interest in these tumors is not, however, limited to their histological aspects. To the clinician, the concept of the pseudo-malignant inflammatory tumor of the intestinal tract is an invaluable resource in the

precise determination of therapy and prognosis of abdominal tumors. Robson observed a man of fifty-five years who presented a tumor of the ascending colon associated with classical symptoms of malignancy. Several years previously this patient developed a similar mass which disappeared spontaneously under observation. This history supplemented by the fact that the mass appeared to be rather fixed and extensive influenced the institution of conservative methods with the result that tumor and symptoms disappeared completely in six months. In Braun's case a diagnosis of carcinoma of the cæcum was made in 1895, but the patient refused to submit to operation. In 1908, this patient was operated upon for gall-bladder disease and careful exploration of the cæcum at this time disclosed no trace of the original tumor. Robson mentions five cases in which colostomy was done for supposed inoperable malignancy of the rectum or sigmoid and in every instance the mass had entirely vanished in periods varying from one to three years. The same writer observed three other interesting large-gut tumors for which short-circuit operations were done. In the first, an aged man, an inoperable tumor of the transverse colon was found; in the second, a male of seventy years, a large mass of the ascending colon causing acute obstruction and in the third a chronically obstructing tumor of the splenic flexure. In all three cases entero-anastomoses were performed as a palliative measure and, in spite of what appeared to be a hopeless prognosis, these patients were in good health from one to three years later. Robson remarks that it is this type of tumor with its presumably hopeless prognosis and the miraculous return to health which has established patent medicines and the charlatan. By the same token this condition not infrequently humiliates and discredits the surgeon who encounters but fails to recognize its significance and concludes his exploration with dogmatic predictions of an early mortality.

The problems, clinical and pathological, presented by the simple inflammatory tumors together with the relatively meagre consideration devoted to them in our own country furnish the justification for the following report of an excellent example of this condition:

Case I.*—A Mexican, twenty-eight years of age, was admitted to Fourth Surgical Division July 1, 1929. A few days before admission he had noted a dull steady pain localized to right lower quadrant accompanied by nausea but no vomiting. Appetite was fairly good but bowels did not move for first three days in spite of strong cathartics taken. The pain became progressively more severe and at night he complained of chill, fever and headache. He had lost ten pounds in weight during the ten days preceding his admission. There was no history of bloody stools, urinary disturbances or radiation of pain. His health previous to present illness had been good and there was no history of malaria, typhoid or previous intestinal disorders. He had never had a chronic cough hemoptysis or venereal infection and had never been operated upon.

Examination disclosed a well-nourished and well-developed male of twenty-eight years. Temperature on admission was 100.6°, pulse 88, and respiration 20. Soon after admission he had a chill lasting one hour, during which temperature reached 103.2°. Urinalysis negative; white blood-cells, 9,200; polymorphonuclears, 78 per cent.; smear negative for malaria. Red blood-cells, 4,700,000. Wassermann negative (post-operative

* Reported before New York Surgical Society, January 12, 1932.

report). The heart was normal. At the apex of the right lung coarse râles were heard. The abdominal muscles were relaxed and there was no distension. In the right lower quadrant a hard, slightly tender, freely movable mass about the size of a large orange was felt. Rectal examination disclosed no abnormalities and the extremities were negative. Pupillary and tendon reflexes reacted normally.

Operation.—In view of the evidences of impending obstruction the patient was operated upon without further X-ray study. Exploration of the abdomen revealed a firm, fairly well circumscribed mass which appeared to originate in the hepatic flexure of the colon whence it seemed to extend into the mesocolon of the hepatic angle. The gut was angulated about the tumor in such a way that the lumen of the former was

FIG. 1.—Photograph of gross specimen, Case I, showing (*a*) tumor at mesocolic angle; (*b*) angulation of hepatic flexure; (*c*) normal mucosa in opened transverse colon.

almost obliterated. The gall-bladder was adherent to the mass and the regional lymph-glands were quite definitely enlarged. A gross diagnosis of carcinoma of the hepatic flexure was made and a radical resection to include the right half of the transverse colon and 10 inches of the distal ileum was done. Mobilization of the large gut disclosed many enlarged lymphatics and marked œdema of the retroperitoneal space. For this reason a side-to-side isoperistaltic anastomosis was carried out and the abdomen closed without drainage.

With the exception of a deep infection of the lower angle of the wound, the patient made an uncomplicated recovery. The wound was completely healed on the nineteenth post-operative day and he was discharged in good condition. During the ensuing several

months this patient was followed in the return clinic and was observed to gain rapidly in weight and strength. Soon thereafter he left the country and has since been lost sight of but when last seen was enjoying good health.

Gross Examination of Specimen.—The ileum and appendix are normal. A firm, fairly well circumscribed mass occupies the angle formed by the hepatic flexure. This mass invades the gut walls but its main bulk is seen to be in the mesocolon. The colon is angulated acutely about the tumor so that the colon distal to it appears to fold back on itself to become adherent to the cæcum. (Fig. 1.) On section the tumor is avascular, homogeneous and whitish with many small yellow areas. The centre is necrotic and an attached node shows a diffuse hyperplastic surface. Upon opening the lumen of the angulated colon it was noted that, although the muscular wall was definitely infiltrated, the mucosa was everywhere normal in appearance, there being no evidence of ulceration, thickening, diverticulum or other pathological change. The

FIG. 2.

FIG. 3.

FIG. 2.—Subserous section from Case I, showing typical picture of granulation-tissue tumor.
FIG. 3.—Submucosal section to show sharp limitation of inflammatory process at muscularis mucosæ.

tumor was subsequently serially sectioned in search of foreign bodies with negative results.

Microscopical Report by Dr. Douglass Symmers.—"Section into the necrotic area shows many polymorphonuclears and necrotic tissue. Outside this, there is new granulation tissue. The rest of the area consists of granulation tissue with many eosinophiles. There is no evidence of tuberculosis or neoplastic tissue. *Diagnosis.*—Chronic productive inflammation with areas of suppuration. Probably healed or healing abscess."

Sections of this tumor were made at various levels in order to determine histologically the relationship of the process to the various elements of the gut walls. Figure 2 represents a subserous section and shows granulation tissue rich in round cells and fibroblasts infiltrating the muscular layers. Round cells predominate the picture against a scattered background of fibroblasts. There are also numerous polymorphonuclears, eosinophiles and mast cells while here and there mitotic figures may be seen. Section through the mucosa and submucous tissues (Fig. 3) shows the inflammatory process

extending up to the muscularis mucosa, which seems to act as a barrier against further extension. Beyond are seen normal intestinal glands which do not participate in the process. A high power of this region discloses the same histological characteristics noted in other sections. No giant cells or foreign bodies could be found in this specimen.

It seems reasonable to conclude from the gross and microscopical evidence presented by this particular case that the process arose primarily from an extra-intestinal focus. The location of the major portion of the mass in the mesocolon, the progressive, but secondary, infiltration of the gut wall fading out at the muscularis mucosæ and, finally, the absence grossly and microscopically of pathological changes in the mucosa itself all lend support to this contention. This conception of the origin of these tumors is of considerable interest in view of the existing theories of their etiology.

Senn[7] is authority for the suggestion that tumor growths of this type derive their original impetus from interference with the local blood supply of a given tissue. As a consequence there follow necrosis and low-grade infection which stimulate in the adjacent areas a reactive reparative process. Necrosis, infection and reactive repair proceed hand in hand but the latter eventually predominates with the resultant progressive piling up of granulation tissue until a tumor-like mass is formed.

However this may be in theory, clinical observation points out certain practical etiological factors which appear to predispose to the development of the infective granulomata. These factors have been well classified by Mock under three headings: (1) Conditions existing within the gastro-intestinal tract or its mesentery; (2) extraperitoneal infections which spread to and involve the gastro-intestinal tract; (3) traumata due to surgical procedures or extraneous injury.

Considering its structure and the physiological demands placed upon it, the mucous membrane lining of the large intestine at once falls under suspicion as a logical source of inflammatory processes involving the gut wall and adjacent tissue. This mucosal area is constantly exposed to minute traumata, ulceration and infection, the results of which must be concentrated somewhere in the subjacent lymphatic or vascular drainage areas. Simple ulcers resulting from the trauma by a harsh intestinal content, ulcerative colitis or even an infinitesimal perforation by foreign body may well be considered as the origin of an inflammatory reaction within the gut wall, its mesentery or both. Perhaps something akin to this sequence of events is exemplified in the tumefactions so frequently associated with diverticulitis of the sigmoid colon. In this condition the characteristic multiple herniations of mucous membrane into and through the muscular coats are inevitably involved in varying degrees of acute or subacute infection. Persistence or recurrence of such process sets up in the adjacent gut wall and its mesentery a reactive inflammatory fibrosis which eventually produces in this region a tumor mass often indistinguishable clinically from the carcinomata. Acquired diverticula of this type, although commonly observed in the sigmoid or descending colon, are occasionally encountered throughout the large and

even at times in the small intestine. The suggestion, therefore, that the inflammatory tumors found in these latter localities may arise in this manner is not unworthy of consideration.

The importance of surgical trauma as a causative factor in the production of the granulomata has been repeatedly stressed and the frequency with which these tumors are encountered at sites previously invaded by surgery lends some credence to this assumption. The exact mechanism through which this etiological relationship develops is not, however, entirely clear. It is, of course, well recognized that surgical transgressions of the peritoneal cavity exact certain undesirable penalties inevitably consequent upon (1) mechanical trauma of the peritoneum; (2) the introduction of extraneous foreign material such as ligatures, suture material, drains, *etc.*, and, where the intestinal tract is invaded, (3) the introduction of bacterial infection and foreign material from the intestine. Any or all of these sources of intraperitoneal irritation are undoubtedly capable of exciting a reactive tissue response similar in character to that seen in the infective granulomata. Nevertheless, it is difficult thus to explain the extreme degrees of reaction characteristic of the granulomata unless one attributes to those so affected, a specific susceptibility to these particular stimuli.

In Moscowitz and Wilensky's series of four cases of granulomata, three had previously been operated upon for acute appendicitis, while in the fourth case an attack of acute appendicitis (not operated upon) antedated the tumor formation. Such evidence carries obvious implications but, unfortunately for the traumatic theory, the possible significance of these figures is nullified by the fact the tumors in this group did not invariably develop at or near the site of operation. On the other hand, of infinitely greater importance was the observation in one of these tumors of an unknown foreign body surrounded by giant cells. Jaffe reported an inflammatory tumor of the colon, in the centre of which a small piece of bone was found, and Schreiber described an ulcerating tumor of the cæcum containing in its substance cherry and plum pits. In one of Mock's cases, a granuloma had developed around a linen purse-string suture applied during an appendectomy several months previously.

The following case which is reported through the courtesy of Dr. J. V. Bohrer is of particular interest in this connection:

Case II.—C. D., a ten-year-old school girl, was admitted to the Children's Surgical Service, Bellevue Hospital, March 25, 1931. Eight months before admission, she had been operated upon elsewhere for acute appendicitis and following this operation a persistent fistula had developed at the lower angle of the incision. She was a well-nourished and developed child whose abdomen presented an indurated right rectus scar. At the lower angle a small fistulous tract admitting a fine probe for a distance of one and one-half inches was found. This area was widely indurated superficially but no intra-abdominal mass could be felt.

Operation.—April 4, 1931, scar excised. Sinus tract followed down to loop of small intestine, excised and base inverted. Rubber tissue drain inserted and abdomen closed.

Patient was discharged May 30, 1931, with wound completely healed and remained

perfectly well until July 15, 1931. At this time, according to history, she received a sharp blow over the site of the incision and one week later lower angle of incision opened and drained intermittently until date of readmission August 3, 1931. At this time, there was noted a well-established sinus at lower angle of wound which was discharging a thin sero-pus. No tenderness or masses detected. Temperature 100.2°.

Operation.—August 10, 1931, abdomen opened through the old scar. The fistulous tract, indurated and well defined, led directly from the abdominal wall to the ileocecal region. At this point, a large, hard mass was found invading the lateral wall of the cæcum and so encroaching upon its lumen as to produce an almost complete obstruction. A wide resection of distal ileum cæcum and ascending colon with subsequent ileocolic anastomosis was carried out.

The patient made an uncomplicated recovery and was discharged from the hospital with wound completely healed by primary union. Follow-up records reveal the fact that she has remained entirely well up to the present time.

On gross examination, the specimen presented a firm, diffuse infiltration of the walls

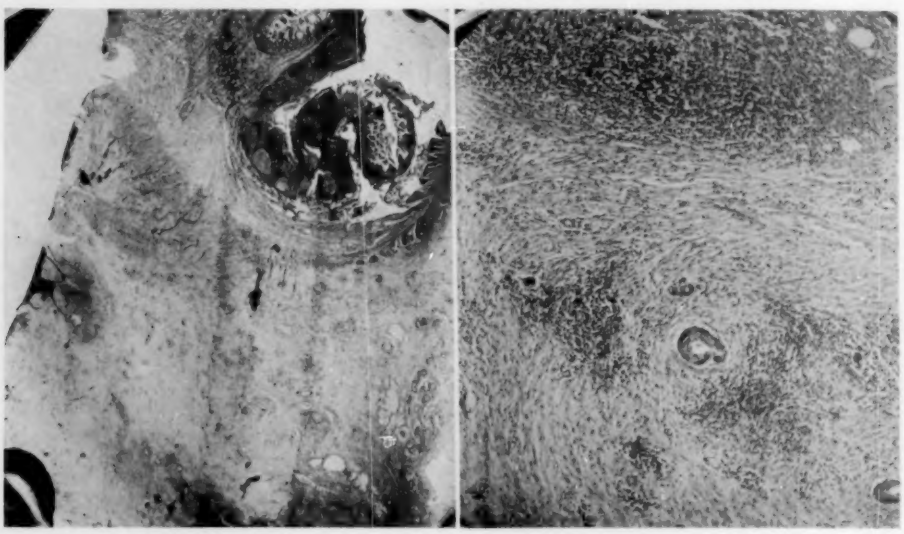

FIG. 4. FIG. 5.

FIG. 4.—Low-power entire field Case II, showing thickening of serosa and muscular coats with numerous old scattered abscesses.
FIG. 5.—High-power Case II to show perivascular infiltration and thickening.

of the cæcum and ascending colon. The lumen of the cæcum was almost completely obliterated by compression and constriction. The mucosa itself, however, was normal in appearance and presented no macroscopical evidence of ulceration or thickening. In deference to the conception that tumors of this type and site arising at this age were most commonly tubercular in origin, a gross operative diagnosis of tuberculosis of the cæcum was made at the time. Subsequent microscopical study of sections revealed a dense fibrous-tissue infiltration involving particularly the muscular coats, and, to a lesser degree, the serosa and submucosa. Particular emphasis was placed at this time upon the presence in the gut walls of numbers of thickened blood-vessels, the process of thickening involving all coats but being especially pronounced between the intima and the yellow elastic lamina—the so-called endarteritis obliterans. This lesion, occurring most frequently in syphilis but occasionally seen in chronic productive tuberculosis, suggested sections stained for tubercle bacilli and spirochetæ but in neither instance were specific microörganisms encountered. In view, however, of the frequency of endarteritis

in association with syphilis and because syphilitic lesions of the lower gastro-intestinal tract were said to be more common than tubercular lesions, the operative diagnosis was revised and patient discharged with the final histological diagnosis of syphilis of the cæcum.

The unusual features of this case stimulated subsequently a review of specimen and numerous fresh serial sections were made for its more intensive study. This study revealed in addition to a dense fibroblastic infiltration of muscular and subserous coats (Fig. 4) marked evidence of a chronic inflammatory reaction characterized by round cell and polymorphonuclear infiltration, plasma cells, cosmophiles and œdema. Numerous old punctate abscesses were scattered throughout and in one area a group of giant cells were seen. In view of these findings the process was interpreted as a chronic productive inflammatory process. Inasmuch as endarteritis is not uncommonly found in association with such a process, it is unnecessary to assume a diagnosis of syphilis to account for the presence of this feature. (Fig. 5.) Accordingly, diagnosis was again revised and finally recorded as infective granuloma of the cæcum.

These experiences with Cases I and II together with numbers of similar instances from the literature throw considerable light upon the behavior of the infective granulomata and emphasize the problems encountered in their treatment. The total number of available cases is too small to permit the luxury of dogmatic conclusions but there are discernible throughout this group common and distinctive features which are of fundamental importance to the proper evaluation of these tumors. It is, in the first place, established that under certain conditions a simple chronic productive inflammatory process may express itself as a well-defined tumor mass whose true nature is usually not suspected at the operating table. Furthermore, although these tumors may occur throughout the digestive tract, they show a distinct predilection for that segment which is conceded to be the favorite site for the neoplasms, namely, the large intestine. Finally, they are capable of imitating any or all of the classical subjective symptoms usually attributed to the malignancies. Thus, the clinical manifestations, distribution and gross characteristics of the infective granulomata all combine to present a picture which is interpreted commonly as malignancy; occasionally as tuberculosis; rarely as syphilis. It is therefore not remarkable that these tumors invariably suffer the fate dictated by these misconceptions. Where the mass is susceptible to removal, a more or less radical resection is the rule; if apparently inoperable, the patient is condemned to some palliative procedure supplemented by a hopeless prognosis. In the latter event the subsequent failure of the condition to proceed to the anticipated fatal termination or the actual spontaneous disappearance of the tumor eventually determines a revised diagnosis. In the former, post-operative histological study discloses the first suspicion of the benign character of the growth.

Identification of the infective granulomata is not, however, merely a matter of academic interest for their early differentiation from the malignant tumors will have an exceedingly practical influence upon both prognosis and treatment. As has been previously pointed out, the granulomata present all the gross and clinical characteristics of malignancy or tuberculosis and, in con-

sequence, are commonly subjected under this impression to the unnecessary hazards contingent upon radical resection. On the other hand, clinical evidence bears witness to the fact that inflammatory tumors of the gastro-intestinal tract respond most favorably to conservative surgical methods and that simple short-circuiting of the tumor by means of entero-anastamosis or enterostomy is adequate to secure a complete and permanent disappearance of the pathology; indeed, in some instances, spontaneous resolution of the process has followed laparatomy alone. Since these conservative measures assure not only satisfactory therapeutic results, but also a better prognosis and a negligible mortality rate, it follows that their substitution for more radical methods approximates the ideal in the treatment of the infective granulomata. It is quite obvious, however, that the employment of such methods must be predicated upon the ability to differentiate these tumors pre-operatively or at operation from the malignancies and this constitutes the essential problem of the infective granuloma.

The solution of this problem necessitates a practical method by which the granulomata may be identified at the operating table when decision as to the type of treatment must be made. It is evident, therefore, that while the microscope offers the sole precise method of diagnosis, the data therefrom are available too late to be a determining influence in this decision. The frozen section suggested to meet this deficiency is at best not ideal and when applied to the study of granulation tissue is particularly susceptible to misinterpretation. Indeed, the frequency with which the infective granulomata have been classified histologically as carcinoma, sarcoma, tuberculosis or syphilis indicates that even under the most favorable conditions of study this tissue presents certain diagnostic problems. These errors are undoubtedly attributable to the protean character of granulation tissue with its fibroblasts, lymphocytes, giant cells, endarteritis, *etc.* The predominance of any one of these elements when considered in conjunction with a positive clinical and macroscopical diagnosis may give impressions suggestive of one of the above tumors. Consequently, deliberate and repeated histological studies are often necessary if the infective granulomata are to be consistently isolated from other tumors of the large gut.

These facts direct attention to the possibilities of macroscopical diagnosis and although it is generally conceded that the granulomata do not possess gross features to distinguish them from carcinomata of the colon, a review of the findings in Case I is worthy of consideration in this connection. It will be recalled, for example, that the gross pathology in this case aroused speculation as to its nature even before the histological diagnosis was obtained. While the tumor appeared to involve the intestine at the hepatic angle, it was observed that there was a disproportionate invasion of the mesentery not commonly seen in the malignancies unless far advanced. It was further noted on gross section that the mucosa was not implicated in the process and that the obstructive manifestations were apparently due to encroachment

upon the lumen from without rather than to constriction arising primarily within the lumen. Similar observations have been made in other cases of granulomata and are particularly significant in view of the theory that these tumors have a primary extra-intestinal origin and that invasion of the gut wall follows secondarily. The epithelial tumors arise in the mucosal lining of the gut to produce primary constrictive effects within the intestinal lumen. Peripheral extension to gut wall and mesentery is a later manifestation and unless far advanced is not so prominent as that described in Case I, where the main bulk of the tumor mass was mesenteric in position. Obstruction in the epithelial tumors should therefore result comparatively early from the effect of primary intraluminary constriction. With the granulomata, however, obstruction should theoretically be a late development and is properly to be considered as due to extrinsic pressure of a progressive parain-testinal inflammatory mass. Viewed in the light of the present discussion the macroscopical findings in Case I appear sufficiently distinctive to suggest gross diagnosis of a non-malignant tumor. If it can be demonstrated by further observations that these macroscopical characteristics exist with any degree of constancy in the inflammatory tumors, then macroscopical differentiation with its attendant advantages may become an accomplished fact. Decision on this important point must await increased experience with the infective granulomata.

In conclusion the salient facts relating to infective granulomata of the gastro-intestinal tract may be thus briefly summarized:

(1) Simple, non-specific inflammatory processes associated with the gastro-intestinal tract may, under certain conditions, express themselves in the form of well-localized tumor masses whose favorite site is the large intestine.

(2) Because of the striking similarity in their clinical manifestations, gross pathology and localization, differentiation from the malignancies or tuberculosis is not usually made macroscopically; consequently radical treatment with its attendant mortality rates and prognosis has been the rule.

(3) The response of the inflammatory tumors to simple surgical methods which insure a good prognosis and negligible mortality rates indicates the importance of pre-operative or operative (macroscopical) diagnosis.

(4) Although histological study offers the sole precise method of differentiation, its evidence is too remote to be of practical clinical value.

(5) The findings in Case I suggest the possibility that inflammatory tumors may present macroscopical characteristics which distinguish them from malignancies of the large gut. If it can be determined by further observation that these distinguishing characteristics are in any degree constant, an important contribution to treatment and prognosis is presented.

(6) The fact that the inflammatory tumors are frequently classified clinically and macroscopically as carcinoma, sarcoma, tuberculosis or syphilis, justifies the assumption that they are more common than statistics indicate.

NOTE.—Shortly after the submission of this article for publication the writer encountered and operated upon the following case, the record of which presents interesting evidence tending to support theories advanced in the above discussion relative to the origin and behavior of infective granulomata.

CASE III.—L. S., twenty-three years of age, was admitted as an acute emergency November 29, 1932, to Mary Immaculate Hospital, service of Dr. John M. Scannell. Four years previously while on a trans-Atlantic liner, he was taken acutely with an abdominal attack diagnosed as appendicitis. Owing to rough weather, however, it was decided to treat the condition conservatively and ice-packs were resorted to up to the time of his transfer to Ellis Island Hospital several days after onset of attack. Immediate operation was carried out and, although operative wound was completely healed

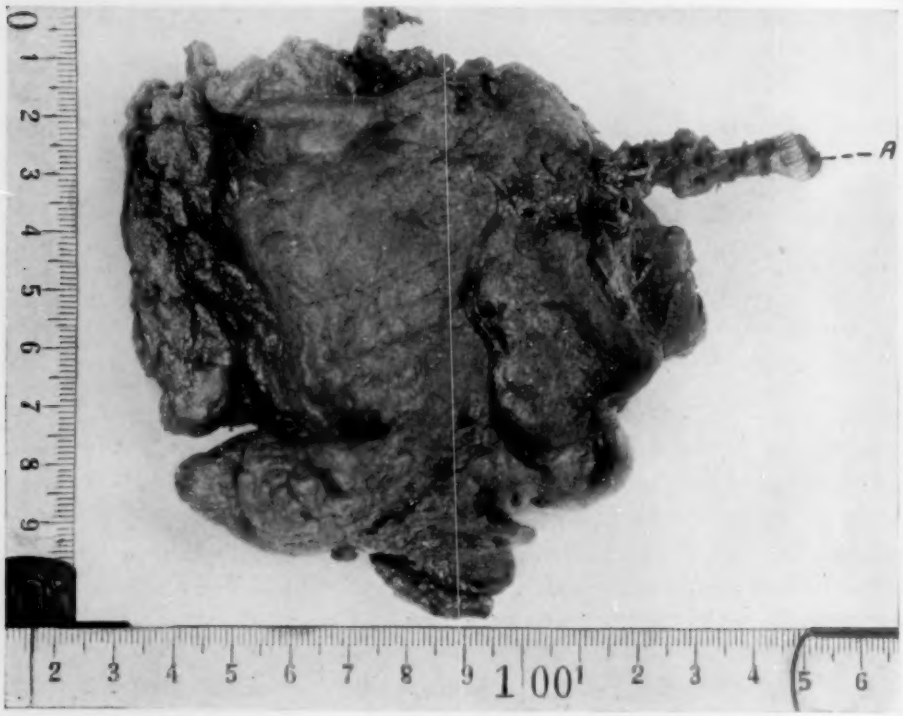

FIG. 6.—Tumor mass with appendix leading into its centre. (*A*)—Base of appendix.

after two weeks, patient was detained at the hospital for thirteen weeks thereafter because of "blood poisoning." One week after discharge from hospital he was again seized with an acute pain in right lower quadrant of abdomen and was admitted to another hospital where a mass in the right lower abdominal quadrant was incised and drained. The wound continued to drain pus for some time and at intervals he suffered from intermittent cramp-like pains in lower abdomen. There was no associated nausea, vomiting, diarrhœa, constipation or urinary disturbance. One week before admission he was taken with a particularly severe attack of this type and had eventually sought admission to hospital because of the persistence of symptoms.

Examination disclosed a slight, pallid, rather poorly developed male of twenty-three years. His rectal temperature was 103°, pulse rate 120; he was perspiring profusely and appeared to be acutely ill.

The abdomen presented in the right lower quadrant, two scars, one a long right

pararectus and the other a short scar in the neighborhood of McBurney's point. The right rectus muscle was rigid throughout, but acute tenderness was localized to right lower quadrant where a firm, fixed mass about the size of a large orange could be detected. Rectal examination was negative except for tenderness to right side of pelvis and in cul-de-sac of Douglass.

The blood count on admission showed 4,380,000 red blood-cells, 15,350 white blood-cells, with 71 per cent. polymorphonuclears. A pre-operativ e count made a few hours later showed white blood-cells 29,550, with polymorphonuclears 91 per cent.

A pre-operative diagnosis of infective granuloma of the cæcum was made on the basis of history, physical findings and laboratory data.

Operation November 29, 1932.—Right pararectus incision. On opening peritoneum, a large, firm, densely adherent tumor mass was found occupying the angle formed by the cæcum, ascending and transverse colons. This mass seemed to arise from the cæcum but was adherent at various points to the anterior abdominal wall and small gut. At

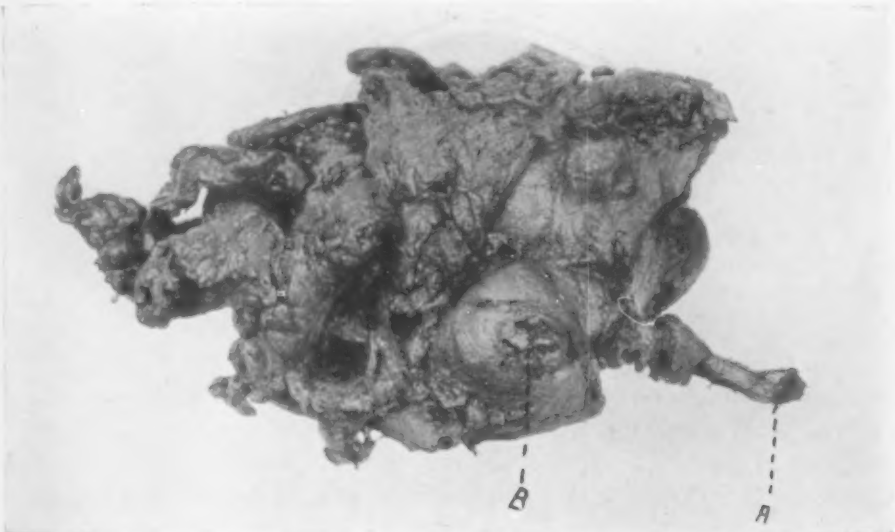

FIG. 7.—Tumor mass with appendix (*A*) showing abscess cavity and foreign body (*B*).

its upper pole an angulated segment of transverse colon was attached and, in the vicinity of this point of attachment, the wall of the large gut presented an area of annular thickening and induration which had encroached upon the lumen sufficiently to produce an acute obstruction. Proximal to this colonic mass the cæcum and ascending colon were greatly dilated whereas distally, the large gut was relatively collapsed. With some difficulty the mass was freed from the abdominal wall, loops of small gut and transverse colon. At the point of attachment to the cæcum, the appendix was found leading into the centre of the mass and at this point a large abscess cavity containing a definite foreign body was disclosed. (Fig. 7.) The entire mass with appendix (Fig. 6) was removed and the obstruction in the transverse colon was short-circuited by means of a colo-colostomy about the obstructing mass. Abdomen then closed after instituting suitable drainage.

Pathological Report (Dr. E. F. Koch).—*Macroscopical Description.*—A mass of tissue with appendix attached measures ten and one-half by twelve centimetres. The distal portion of appendix shows a perforation with a foreign body present and protruding from the lumen. Section of the appendix reveals mucosal proliferation, fibrosis and subserosal hæmorrhage. The serosa of the distal portion is completely

denuded. Section reveals a small lumen, mucosal proliferation and fibrosis. Section through wall appears to be granulation tissue and reveals hæmorrhage and fibrosis with scattered areas of adipose tissue. The centre of this mass appears necrotic.

Microscopical Description.—Sections show appendix embedded in a dense mass of granulation tissue. Appendiceal mucosa show tremendous glandular hyperplasia and infiltration by round cells, plasma-cells and eosinophiles. Dense fibrous mucosal scars which show chronic inflammatory cellular infiltration give evidence of previous acute inflammatory process. Sections of the main mass of tissue show it to consist in its entirety of inflammatory granulation tissue and fibrous tissue in various stages of maturity. There is no evidence of specific inflammation or of malignant neoplasia.

Pathological Diagnosis.—Chronic diffuse appendicitis. Non-specific peri-appendical granuloma.

Post-operative Course.—Convalescence proved to be a bit stormy and some degree of wound infection developed. The patient was, however, discharged from hospital sixteen days after operation with temperature normal, wound healed and free from subjective symptoms. He remained perfectly well until December 20, 1932, or for a period of two weeks after operation. At this time he was readmitted to the hospital complaining of acute epigastric pain and persistent vomiting. The abdomen was generally distended and tender but no masses could be felt. An immediate laparotomy carried out by Dr. M. T. Reynolds disclosed an acute obstruction due to strangulation of a loop of ileum or jejunum by band of adhesions. The stoma established at former operation was found to be patent and functioning but unfortunately there was no note as to the status of the granulomatous mass in colon. The patient made a good recovery following this procedure and was discharged from the hospital December 31, 1932, being eleven days after second operation.

In analysing this case record, the following features should be stressed as pertinent to the foregoing discussion of the infective granulomata.

(1) A correct pre-operative diagnosis based on history and physical findings and confirmed by gross inspection made possible relatively conservative surgical treatment of the obstruction, *i.e.*, entero-enterostomy.

(2) The microscopical characteristics of the process: "inflammatory granulation tissue and fibrous tissue in various stages of maturity."

(3) The macroscopical characteristics of the process: a large solid tumor mass with multiple abscess formation and a definite foreign body at its centre developed on a basis of a recurrent acute appendicitis previously subjected to two operations. (Figs. 6 and 7.)

(4) The secondary extension of the process to the walls of the transverse colon producing an obstructive annular induration suggestive of neoplasm. This feature confirms not only the obstructive potentialities of these tumors but, of greatest significance, establishes the extra-intestinal origin of this particular large-gut granuloma.

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PRIMARY MUCOID CARCINOMA OF THE RECTUM IN A THIRTEEN-YEAR-OLD GIRL

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Although malignancy of the bowel is prone to attack individuals in the "cancer age," namely, from forty to sixty years, malignant tumors are not infrequently found in young people. In the main, these are sarcomas, but carcinomas may occur. Thus, Cullingworth, in 1877, reported a huge, pedunculated tumor of the pylorus occurring in a ten-day-old infant. This had the general structure of a cylindrical-cell carcinoma, but the author was inclined to regard it as a congenital adenoma. Clar, a few years later, described a medullary carcinoma of the colon in a boy of three years and Duncan reported a carcinoma of the ileum in a boy three and a half years old. Nothnagel found an adeno-carcinoma of the cæcum in a twelve-year-old boy. Kanthack and Furnival reported a carcinoma of the colloid variety in the ascending colon in a seventeen-year-old male. Garrard reported a similar case in the sigmoid flexure of a twelve-year-old boy. Osler and McCrae collected from the literature six cases of carcinoma occurring in the first and thirteen in the second decade of life. The authenticity of these cases is to be doubted, however, since the authors pointed out that exact diagnosis was questionable. Several cases aged from fifteen to twenty years have been reported. Marble reported a case from this hospital of an adeno-carcinoma in the stomach of a seventeen-year-old girl. The majority of carcinomas have been of the so-called adeno-carcinoma type or of an embryonic variant. Only two cases of the so-called colloid or mucoid carcinoma have been found in the literature occurring in an individual under the age of twenty years.

In an unpublished paper the author has reviewed all of the cases of so-called colloid carcinoma, and differentiated between the primary carcinoma of mucoid-secreting cells and the mucoid deposition accompanying degeneration secondary to adeno-carcinomas. None of the primary mucoid carcinomas occurred in individuals under the age of forty years. The finding of a primary mucoid carcinoma of the rectum with widespread skeletal metastases in a girl of thirteen years has therefore seemed of sufficient importance to justify its publication.

Case Report.—*Path. No. 47148.*—The patient was a white girl thirteen years of age. She was admitted to the Mary Fletcher hospital on the service of Doctor Buttles in October 19, 1931, complaining of severe pain in the lower part of the back. The onset

of the pain followed an injury suffered when she fell against her bed four weeks before admission. On the morning after this injury she had pains in the lower lumbar region which were sharp and continuous. She was unable to walk without assistance. Her attitude in standing was one of flexion and she frequently placed her hand over her hip-joint. On admission to the hospital, her appetite was poor, and she was very restless. Her bowels were regular and required no cathartics. The onset of menstruation was in

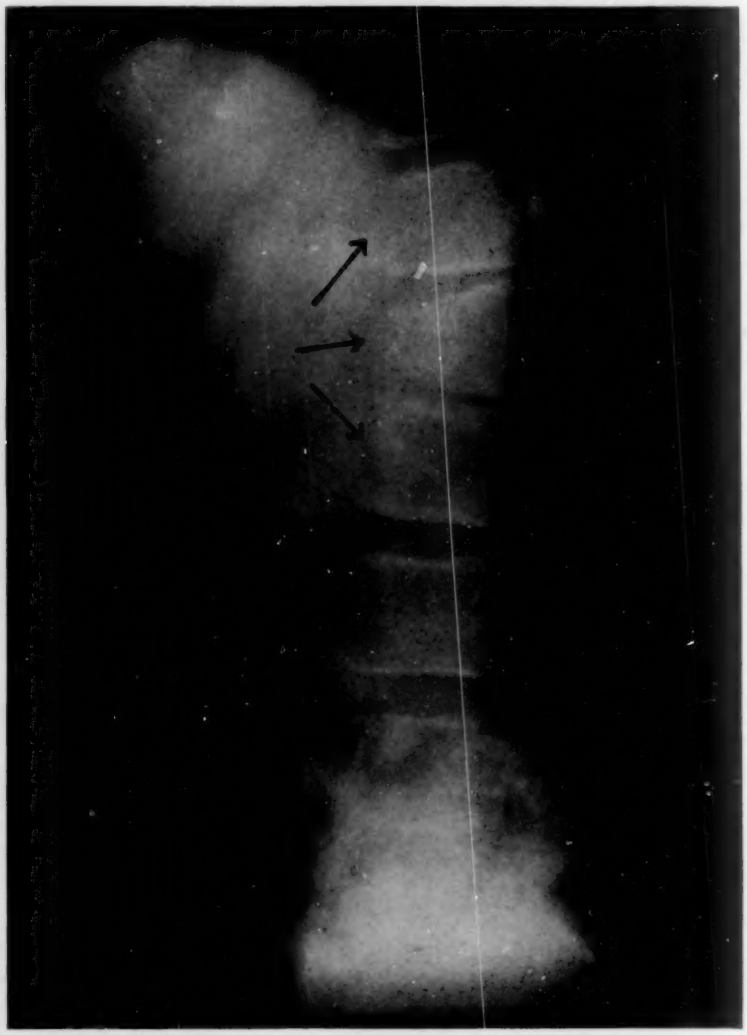

FIG. 1.—Röntgenogram of spine, lateral aspect. The first lumbar vertebra is eroded and flattened, causing a moderate dorsal kyphosis. The second is rarefied, but shows no marked distortion. The twelfth thoracic is also eroded on the anterior aspect but as yet shows no flattening.

May of the same year. Her periods had always been regular, but associated with some discomfort. There was nothing significant in her family history, except that eleven brothers and sisters had died in early infancy for which the causes were unknown.

The girl was well developed, but poorly nourished. She was in no acute distress when admitted. The thorax showed a moderate degree of emaciation with prominent bony land marks. There was increased dullness on percussion over the left base

posteriorly. Fine râles were heard over the left apex during inspiration. There were no significant findings in the examination of the abdomen other than tenderness on deep pressure in both lumbar regions. There was marked pain in the right hip-joint on walking. This pain did not radiate. She was unable to flex the spine while in a sitting position. There was a slight lateral angulation in the lower thoracic region. The neurological examination was essentially negative.

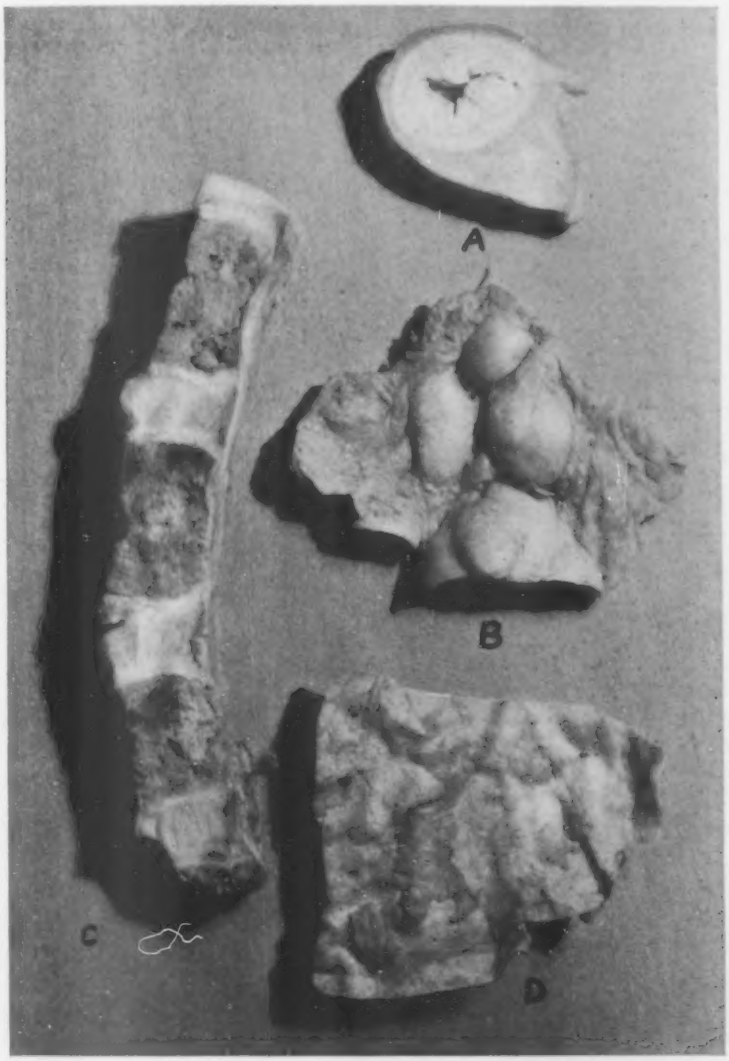

FIG. 2.—Photograph of gross material removed at autopsy. *A*—Cross-section of the rectum showing infiltration of the wall and extension out along the mesentery. *B*—Mass of glands from mesentery near rectal tumor. *C*—Section of lumbar vertebræ, showing partial destruction of bone by secondary tumor deposits. *D*—External aspect of a portion of the dura with tumor implants.

Laboratory Examination.—Blood: 85 per cent.; red blood-cells, 4,150,000; white blood-cells, 5,250; differential count, normal. Urinalysis: A slight amount of albumin and many pus-cells were the only positive findings in the first specimen. These were absent in the second and all subsequent specimens. X-rays of the heart and lungs essen-

tially negative. The lateral and anterior-posterior plates of the spine showed a marked erosion of the first lumbar vertebræ with some flattening of the twelfth dorsal. (Fig. 1.) The condition was temporarily diagnosed tuberculosis of the spine and palliative treatment instituted.

Course in the Hospital.—The patient vomited frequently every day for about a week, and complained of acute pain in the lumbar region. She became constipated and enemas were necessitated for two days, after which cascara was sufficient to sustain catharsis. Four days after admission she was placed in an extension apparatus. The pain continued for several days, then gradually diminished. Several lumbar punctures were performed. The first showed normal pressure, but many red blood-cells. The second showed an increased pressure with no chemical or microscopical abnormalities. The remaining examinations of the spinal fluid were negative. The temperature varied from 99° to 102° during her stay in the hospital. The patient was restless most of the time and continued to vomit at irregular intervals. It was apparent that she was growing

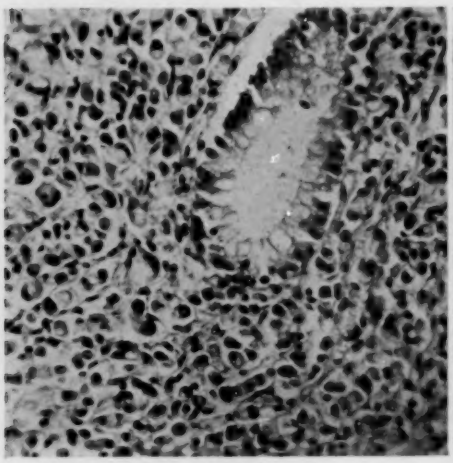

FIG. 3.

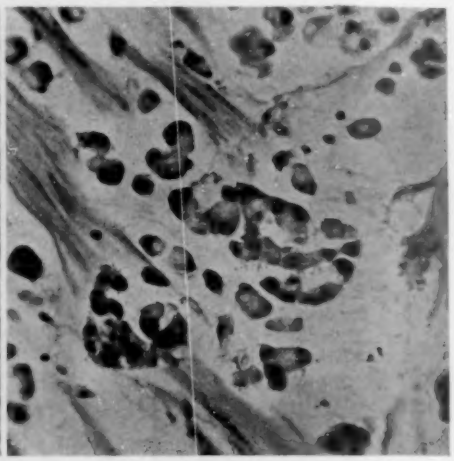

FIG. 4.

FIG. 3.—High-power photomicrograph of a section from the rectum. Note the portion of a crypt that appears unaffected by the tumor. Entirely surrounding it, however, and apparently arising from the epithelium adjacent are many malignant cells growing independently and without semblance of alveolar arrangement. The majority of these are polygonal in shape and variable in size. A few are distended by mucus and the nuclei are pressed to one side. The cells are separated by a fairly well developed stroma.

FIG. 4.—High-power photomicrograph of malignant cells lying deep in the muscular part of the rectal wall. Several have assumed the signet-ring shape and are lying free in deposits of mucus. The muscle fibres are being invaded and destroyed by the tumor.

progressively weaker. The bowels remained open and required no further cathartics. The patient failed rapidly and died November 30, 1931.

Pathological Report.—The autopsy findings were essentially negative except for the gastro-intestinal tract and the skeletal system.

Gross Pathology.—Rectum: (Fig. 2*A*). The rectal wall was thickened, fibrous and indurated, and the lumen was partially occluded. On cut section it was a clear, translucent white. The mucosa was not ulcerated. There was a marked angulation brought about by the infiltrating tumor growth. In the angle formed by the bowel were several enlarged lymph-nodes. Some of these were firm and white, others soft and spongy. *Cranial Vault*: Examination of the brain showed moderate œdema with flattening of the convolutions. There was no evidence of meningitis. The outer surface of the left dura (Fig. 2*D*), presented many flat, soft, elevated areas. These were granular in appearance, and seemed to be loosely attached. There was an area of hæmorrhage three by four centimetres in diameter beneath the endosteum of the left parietal bone. Beneath this were numerous areas of erosion in the bone, varying in size from several

millimetres to several centimetres in diameter. Over these areas and between the bone and dura were masses of pale, necrotic-looking material. All the bones of the skull were involved in the same manner to a lesser degree. *Skeleton*: A similar process with multiple, necrotic pockets filled by cheesy purulent material involved the ilium, the sacrum and all the lumbar vertebræ. (Fig. 2C.) A few such areas were also found in the sternum and ribs. The first lumbar vertebra was markedly eroded and showed posterior angulation. From the gross examination it was thought that this was a metastatic tumor arising in the rectum with secondary involvement of the skeletal system, lymph-nodes and the dura. It was evident that the child had died from the effects of a hæmorrhage brought about by erosion of the cranial bone.

Microscopical Examination.—Rectum: The sections taken from the rectum showed mucous membrane which was essentially normal in most of its extent, but which at one point changed over into a very dense malignant tissue, apparently arising from the epithelium of the mucosa. The cells in the upper layers were rather large, irregular,

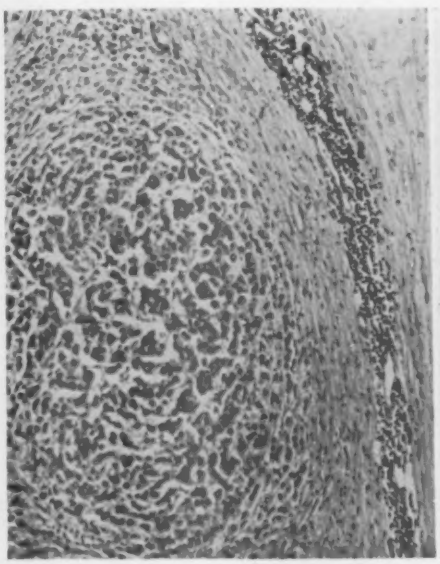

FIG. 5.

FIG. 6.

FIG. 5.—Low-power photomicrograph of a section from one of the mesenteric nodes. This shows a secondary nodule located near the periphery of the gland. The cells are essentially of the same type as those in the original tumor of the rectum but the mucus secretion is less marked.

Fig. 6.—Low-power photomicrograph of a nodule from the dura. This shows a mass of tumor-cells attached to but not invading the dura. They are similar to those of the original tumor but are not actively secreting mucus. In this location the tumor resembles the so-called medullary carcinoma.

and stained deeply. The cytoplasm was moderate in amount and the nuclei were polygonal in shape. From this superficial location, the cells extended downward through a thickened submucosa into the muscularis which was partially destroyed by the invading tumor-cells. (Fig. 3.) Malignant cells could be seen throughout the entire thickness of the rectal wall. In the deeper portions of the tumor, the cells assumed a signet-ring shape typical of those characteristic of mucoid carcinoma. (Fig. 4.) In the isolated nests of cells in the muscular layer there were, in addition to the signet cells, extravasations of mucus, forming small accumulations of a clear, amorphous material. *Glands*: (Fig. 5.) The same type of tumor-cells had entirely displaced the normal structure of the gland. They were large and irregular with a fair amount of granular cytoplasm and irregular polygonal nuclei. Occasional signet-ring cells could be seen, but there was not the marked extravasation of mucus characterizing the primary bowel tumor. *Dura*: (Fig. 6.) The section taken through one of the small white placques of the dura

showed essentially a normal structure on the surface of which had been deposited a mass of malignant tissue. These cells were identical with those in the sections from the rectum and glands were apparently adherent and growing into the dura. They had not perforated it, however, and did not involve the brain. *Bone*: A section through one of the typical areas in the bone showed a poorly outlined mass of necrotic material in which were nests of tumor-cells and bits of necrotic bone. The tumor-cells were of the type described in the other lesions. In parts of the sections one could also distinguish active invasion of the bone by tumor-cells.

Diagnosis.—Primary mucoid carcinoma of the rectum, metastasizing to mesenteric glands, the dura and the skeletal system.

Discussion.—The feature of greatest interest in this case is the appearance of such a malignant tumor in a person of early youth. Malignancy of the bowel occurs with the greatest frequency in patients between forty and sixty years of age. As previously stated, they are not unheard of in the first two decades of life. However, most of the malignant tumors occurring at that age are sarcomas, most frequently of the lymphosarcoma type. That carcinoma arising from the epithelium of the bowel wall should have arisen and metastasized so widely at the age of thirteen years necessitates origination and development at an even earlier age. Such a case as this is of extreme rarity, and it is believed individual in its occurrence. It was remarkable that no symptoms of bowel obstruction were present other than moderate constipation. This is explained by the fact that the tumor had infiltrated the wall rather than producing an ulceration inside the lumen. Although the rectum was converted into a rigid tube, there was no marked obstruction. In dealing with a tumor of this type, one must remember that it is an atypical growth and does not necessarily conform to the mode of extension commonly found in older patients, namely, the ulcerating carcinoma which encircles the bowel and produces an annular constriction. Furthermore, tumors occurring in young people are generally recognized to be more malignant and grow with much greater rapidity than those in older patients.

One may think it amiss that the presence of a bowel lesion was not suspected. However, the diagnosis of tuberculosis of the spine so well fitted the picture that the rectal symtoms of moderate constipation were justifiably given no significance. No doubt, had a gastro-intestinal series been made or a barium enema given, the condition would have been recognized.

The widespread metastases indicate a tumor of unusual malignancy. The secondary growths, however, were located in the skeletal system, a feature which is unusual among gastro-intestinal tumors. The majority of neoplasms in the intestine metastasize first to the mesenteric and retroperitoneal lymph-nodes and then to the liver. In this instance the liver had apparently escaped invasion entirely as the tumor showed a predilection for the skeletal system. The deposits of tumor on the dura can unquestionably be explained as implantations from the opposing skeletal metastasis. Death was due to increase of intra-cranial pressure, caused by hæmorrhage pressing on the cerebral hemisphere.

The onset of the symptoms was coincident with an injury and by some

may be considered related to the trauma. However, as is frequently the case with tumors of bone, this means simply that the injury was the factor calling attention to a pathological process which had no doubt been in existence for several months. There is no treatment which could have possibly been instituted to better the prognosis. The multiplicity of the skeletal lesions contraindicated the use of irradiation. Had the condition been recognized antemortem, section of the sensory fibers of the cord above the lesion might have given the patient temporary relief.*

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ECTOPIC CHORIONEPITHELIOMA

REPORT OF CASE IN WHICH THE LESION WAS SITUATED IN THE JEJUNUM

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This report and discussion has been stimulated by the occurrence of a very rare lesion (ectopic chorionepithelioma) in a portion of the digestive tract (jejunum) which is but rarely the site of a new growth.

The designation "chorionepithelioma" was first used in 1895 by Marchand,[12] who clearly showed the relationship of the tumor-cells to chorionic elements. The tumors which he described all developed in the uterus and gave rise to varied metastases. In 1902, Zagorjanski-Kissel[25] reported eight chorionepitheliomas appearing primarily in the vaginal wall and one case in which the neoplasm was found in the brain and lungs without a primary tumor of the genitalia. In 1905, Dunger[6] referred to such cases as "ectopic chorionepitheliomas."

Etiology.—Zagorjanski-Kissel[25] and several subsequent authors present the view that there are certain chorionepitheliomata which do not arise at the site of placental attachment but rather in distant foci, probably originating from chorionic cells or villi which have penetrated maternal vessels and have been more or less diffusely deposited.

The trophoblast is a normally invasive tissue. Chorionic cells possess the property of digesting the maternal tissues. It is believed that embedding of the ovum is accomplished in this way. They are also endowed with a marked capacity for growth, and, while bathed in maternal blood, they may be broken off and carried by the maternal circulation. The uterine musculature is commonly invaded to a considerable depth by chorionic wandering cells. Masses of trophoblastic tissue and even clumps of chorionic villi may be found in the veins of the uterine wall; or they may be deported to distant fields, more particularly the lungs. Such trophoblastic pulmonary emboli occur in 80 per cent. of women during normal pregnancy according to Schmorl's[20] well-known studies. Here, then, we find invasion and metastasis or embolism by a parasitic tissue to be physiological. So similar in constitution and function are chorionic epithelium and malignant tissue of somatic origin that Blair Bell[2] has hypothecated that chorionic epithelium, particularly the syncytium, is originally malignant in nature, though after a few weeks it comes normally under the control of the developing fœtus, that is, its growth is normally arrested at a stage when its functions must subserve the dependent developing embryo. The growth of the chorionic elements is restrained and kept within physiological limits, those in the uterus being ex-

pelled with the placenta at birth and those that happen to be carried by the maternal circulation to the lungs, absorbed.

By checking the advance and further development of dispersed cellular elements the organism of the pregnant woman preserves its integrity from destruction in the same way that it protects itself from bacterial or parasitic invasion. Oscar Fränkl[8] showed that the serum of a normal pregnant woman is lytic to chorionic epithelium while serum from a patient with chorionepithelioma lacks this lytic power. It is possible, therefore, that the "physiological metastases" of chorionic cells in normal pregnant women are destroyed by this lytic principle. If this capacity is absent, the possibility for the development of a tumor is given. The tumor may develop primarily in the uterus or may develop primarily in organs distant from the uterus (primarily ectopic chorionepithelioma).

Schmorl examined the lungs of 158 patients dying at different stages of pregnancy or after delivery. In 80 per cent. of the normal pregnancies, as mentioned above, he found chorionic cells in the lung capillaries; in 100 per cent. of the eclamptics the lung capillaries contained chorionic elements, sometimes causing extensive obstruction. In two cases of hydatidiform mole and in one of partial mole he noted large numbers of chorionic cells in the lung capillaries and found evidences of proliferation. On the other hand, during the early period of pregnancy he found chorionic elements in the lungs relatively infrequently. Schmorl,[21] therefore, believed that "ectopic chorionepithelioma" might originate from a previous mole or chorionepitheliomatous proliferation of a placenta completely expelled by labor; *i.e.*, from cells altered *before* leaving the uterus; the alteration, he believed, could be confined to a small area of the placenta. Marchand[11] and Pick,[16] on the other hand, maintain that chorionic cells or villi deposited during normal pregnancy may likewise give rise to chorionepithelioma, and that most cases of ectopic chorionepithelioma reveal a history of normal pregnancy, a mole being relatively rare. Walthard[24] reports a case of a primary ectopic chorionepithelioma of the vagina developing along with normal pregnancy. A cæsarean section and total hysterectomy were performed and no evidences of either tumor or mole were found in the uterus. This case was used to support the opinions of Marchand and Pick, but the interpretations may be questioned because of the known long latent periods which sometimes occur with these tumors. Koritschoner,[10] for example, reports an ectopic chorionepithelioma twenty-two years after the last delivery; but such an extended period may be accepted with due reserve, as the occurrence of an early, overlooked abortion during this long period has to be taken into consideration.

Chorionepithelioma may occur where there is no history or possibility of pregnancy. Teacher[23] believes, with considerable plausibility, that chorionepitheliomata found apart from pregnancy are teratomas "arising from some structure which has the morphologic value of an included ovum and that the chorionepitheliomatous elements represent the actual trophoblast of the in-

cluded ovum." Such lesions have been found most often in the ovary, testis, liver and mediastinum.

In 1927, Bostroem[3] introduced a new and very hypothetical interpretation of the origin and development of chorionepithelioma. He states that the tumor arises, not from chorionic cells, but rather from undifferentiated germ cells ("serotinal wandering cells"), which, irritated by humoral influences, react by proliferation, forming primary tumor-cells. The latter, by a process of amitotic division, become syncytial cells which, in turn, by further differentiation give rise to Langhans cells. According to Bostroem's theory, "metastases" are not products of a primary tumor but are the result of an irritative action on undifferentiated germ cells in other organs, similar to that causing the primary tumor. In this sense "metastases" are "sister tumors." de Zalka,[5] in a comprehensive discussion of this subject, feels that the possibility of a humoral exciting agent may well exist.

CASE—The patient was a thirty-two-year-old Italian housewife referred to the Surgical Service by Dr. S. Gargill, on November 4, 1930, with the complaint of increasing weakness of three months' duration and tarry stools of six days' duration.

She had been well until three months before admission when she noted increasing weakness with the gradual appearance of palpitation, dyspnœa and marked weakness on exertion. There was no precordial pain or œdema. For three weeks before entry she had a "feeling of soreness" in the epigastrium, unrelated to meals and unrelieved by food; for six days before entry she suffered nausea and vomiting about thirty minutes after taking a greenish medicine, and her stools had become black. There was no hematemesis, abdominal cramps, diarrhœa or constipation. Despite treatment she became worse and was forced to bed five days before entry. For six days there were yellow spots before her eyes with blurring, and for three days she had double vision and tinnitus.

Her family history was irrelevant. She had three children, all healthy, and her last pregnancy, according to her story, ended in a miscarriage after two months in December, 1927. She attributed this mishap to overwork. (On further investigation after her death, we learned that this patient entered the Middlesex Hospital, Cambridge, on December 25, 1927, complaining of uterine hæmorrhage. Her last period occurred on October 3, 1927. She missed her November 3 period but began to flow November 20, since which time she had been flowing steadily and profusely. On the night of her admission she expelled a large number of "black clots without membrane." After the sixth day the bleeding subsided and she was discharged, without operation, January 7, 1928. No microscopical examination was made. Two weeks after she left the Middlesex Hospital, she began to bleed again; her family doctor curetted her at home and reports that he found nothing unusual.)

Physical examination showed a restless, anxious, pale woman of good development and nourishment. Her mucous membranes were pale. Heart was normal in size with sounds of good quality. Rate, 120; regular rhythm with a rough blowing systolic murmur heard all over the precordium, best over the mitral area; diastolic blow over the mitral area. P 2 greater than A 2. Blood-pressure: systolic, 100, diastolic, 50. Lungs were clear throughout. The abdomen was negative save for slight epigastric tenderness. Pelvic examination showed moderate cystocele and rectocele; cervix slightly lacerated and cystic; fundus normal in size, in retroposition; vaults clear. Examination of the extremities showed a few bilateral varicose veins. Temperature was 100.6° (rectal); respirations 28.

Clinical Pathology.—Urine essentially negative. Red blood count, 1,620,000; hæmoglobin, 30 per cent. (T.); white blood count, 12,900; differential count showed 90 per cent. polymorphonuclears, 9 per cent. lymphocytes, 1 per cent. large mononuclears. No anisocytosis, occasional tail forms, moderate achromia, platelets normal. Stools were black, formed, and showed a strongly positive benzidine reaction for occult blood. Blood culture, negative. Hinton, Kahn and Wassermann reactions negative.

Clinical Progress.—On admission diagnosis was made of: secondary anæmia, ? rheumatic heart disease, ? subacute bacterial endocarditis and ? gastro-intestinal bleeding. The patient was placed on a first-stage Sippy régime without powders; was given glucose and saline by rectum; also morphine. She was given two transfusions of 500 cubic centimetres each on the second and fourth days after entry; there was only slight improvement. Six days after entry (November 10) she developed phlebitis of the right thigh. November 16 occult blood still present in stools; no improvement in blood picture. Treatment changed to water by mouth and rectal glucose. November 18 third transfusion. November 19 red blood count 1,740,000. Gastro-intestinal X-rays showed "a slight irregularity of the lesser curvature at the prepylorus and a constant incisura opposite this irregularity in the greater curvature with assymmetry of peristaltic waves in this region. These findings point to a lesion in this region." November 22 fourth transfusion and exploratory laparotomy. Dr. H. K. Sowles, spinal anæsthesia. "Median epigastric incision made. There was a mass as large as a small orange in the edge of the left lobe of the liver. On the under surface of the liver this mass had ruptured through the capsule, and the omentum was adherent to the liver at this point. Duodenum, pylorus and stomach seemed perfectly normal. No signs of any bleeding. Wound in the duodenum was closed. Mass on the edge of liver felt fluctuant; it was explored with a needle and nothing found. It was also explored by blunt dissection with finger tip from the under side. It seems to consist of a soft, dark, blood-stained tissue nearly black in color. Very little bleeding. Piece of liver removed for pathological examination. Because of the patient's general condition, the rest of the abdomen was not explored. Wound closed without drainage." Pathological report of biopsy S—30—1074: "Hematoma of liver and omentum."

FIG. 1.—The gross specimen showing the hæmorrhagic, necrotic, crater-like ulceration in the jejunum.

November 24 evidence of bronchopneumonia. December 2 acute phlebitis in right leg and thigh with swelling. Bronchopneumonia disappeared but patient continued to go down hill. Stools continued to contain occult blood and red blood-cells kept dropping (1,500,000).

December 5 resection of tumor of small intestine, end-to-end anastomosis, fifth transfusion by Dr. Charles G. Mixter under spinal anæsthesia. When the abdominal cavity was opened a mass about the size of an orange, the color of an eggplant, was seen protruding from the left lobe of the liver and adherent to omentum. Ligament of Treitz was exposed and small bowel was followed down from this point for four to five feet when a lemon-sized mass originating in the intestine and tending to perforate into adherent omentum was found. There were several bean-sized glands in the

mesentery of the small intestine in this region. About fourteen centimetres of intestine were resected; end-to-end suture. Because the specimen seemed to be malignant, further investigation of the liver tumor was deemed inadvisable. Patient transfused.

December 7 operation was followed by paralytic ileus which was relieved by inlying Levin's tube. Wound sepsis (minor).

December 14 phlebitis right leg flared up again. Ascheim-Zondek test strongly positive. X-rays of long bones and chest negative for metastases. Intensive X-ray treatment begun. Stools negative for blood.

December 22 despite deep therapy to abodmen and liver (six treatments, each of 200 "r" units), the mass in the liver seems to be increasing in size, down to the umbilicus. Increasing weakness and restlessness; loss of appetite. January 5, 1931, died. Pathological examination and report by Dr. Monroe Schlesinger.—Specimen consists of a strip of the wall of the small intestine. It presents a large bulging hæmorrhagic mass on its external surface. (Fig. 1.) The strip of gut measures 13.5 centimetres long, and has a circumference of 5.5 centimetres. In the middle of this portion of tissue the bulging mass from the external surface is seen. It measures five centimetres

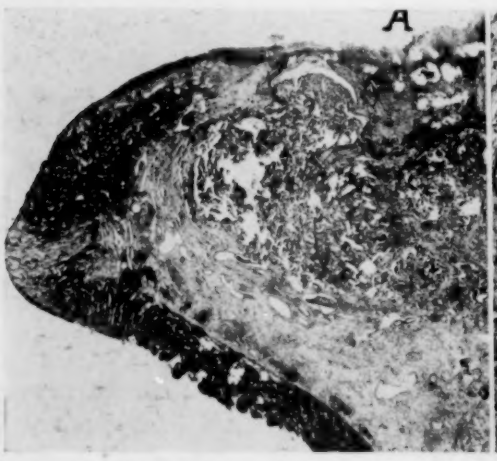

FIG. 2.

FIG. 3.

FIG. 2.—Low-power view showing invasion of mucosal surface of gut. The coagulum of red blood-cells and fibrin may be seen at A.

FIG. 3.—High-powered detail from Fig. 2, showing invasion of lumen of blood channel by tumor-cells.

by three centimetres. There is a considerable amount of yellow, fatty and fibrous omental tissue wrapped around it. When this is lifted up the mass is seen to be hæmorrhagic and necrotic. There is a clear wavy line of demarkation between the hæmorrhagic tissue and the adjacent tissue, which, however, is grayish in color, and beyond this gray zone it gradually merges into the normal-appearing pinkish coat of the intestine. It feels soft and doughy throughout. Looking at this area from the inside one sees a large crater-like ulceration about five centimetres across and 3.5 centimetres long. The longer measurement is parallel with the transverse diameter of the gut. This ulcer is hæmorrhagic and necrotic and has rolled-up edges of 0.3 centimetres in thickness. The ulcer presents elevated areas of necrotic hæmorrhagic tissue with intervening furrows and ridges. It shows a coloration of black, yellow and red areas. The base of this ulcer presents a convexity facing the lumen of the gut. These firmer elevated masses of tissue can be felt in contrast to the softer and thinner tissue. The cut surface shows grayish, hæmorrhagic, and black areas. The base shows a thickness of 0.2 to 0.5 centimetres and the edges are 0.5 centimetres thick.

Microscopical sections from the border and base of the ulcer show an abrupt cessa-

tion of the normal mucosa with glands, lymphoid tissue, *etc.*, at the border of the ulcer. Then, there is a zone of granulation and inflammatory tissue heavily infiltrated with polymorphonuclears and round cells. (Figs. 2 and 3.) Nearer the base of the ulcer the tissue is entirely necrotic and hæmorrhagic and in some places heavily infected with bacteria. This necrosis extends almost through the wall. Near the serosal surface the tissue is better preserved and here it is infiltrated with tumor. This tumor infiltration extends as a zone completely about the necrotic area and is found well out in the various layers of that part of the intestine covered by fairly well preserved mucosa. The tumor consists of an irregular jumble of various kinds of cells all epithelial in nature. These cells can be placed in two groups, one having abundant, pale pink, somewhat foamy cytoplasm, and a large, irregular-shaped vesicular nucleus often with a nucleolus. Many of these cells form multinuclear giant tumor-cells. Many have very large loose nuclei. Mitoses are numerous in these cells. Closely intermingled with this type of cell are small strands and masses of cells having smaller, more uniform and more compact nuclei. Their cytoplasm is usually somewhat more purplish than the other tumor-cells and these cells are usually multinuclear. These two types of

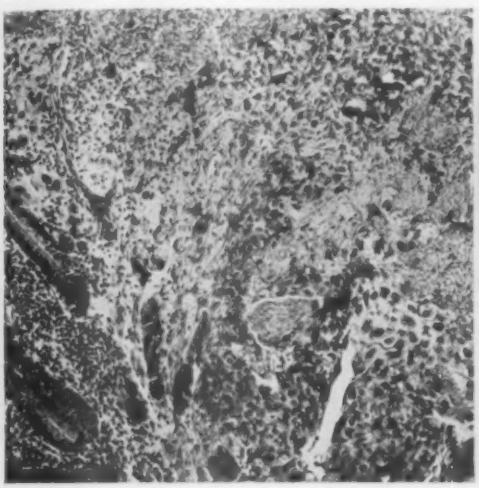

FIG. 4.

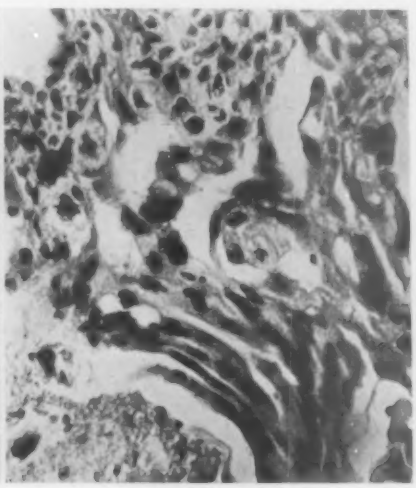

FIG. 5.

FIG. 4.—Study showing the deeply stained syncytial cells and the lighter Langhan's cells; also débris, red cells and fibrin.

FIG. 5.—High-powered study of both types of cells; many mitotic figures are present.

cells represent the Langhan's layer and the syncytial layer. However, they are here inextricably mixed up and both are growing into the normal structures in an apparently unopposed, very active fashion. They can be seen growing through the walls of blood-vessels and also completely filling a blood-vessel. Areas of marked hæmorrhage are found throughout. In the few larger areas of tumor which are not necrotic there is a very scanty stroma consisting mainly of small capillaries. *Diagnosis.*—Ectopic chorionepithelioma of jejunum.

Further sections were made of the original biopsy specimen from the liver and careful study showed that "in spite of the generalized necrosis there are recognizable a few small groups of cells which closely resemble the chorionepitheliomatous cells found so abundantly in specimen 30-1074."

Post-mortem examination was limited, unfortunately, to the uterus, tubes and ovaries. The uterus and tubes showed evidence of chronic endometritis, chronic myometritis and chronic salpingitis. The findings in the ovaries are worth a detailed report.

Specimen 30-1074A.—"The ovaries are oval in shape and yellow in color. They measure 3 by 1.5 by 0.5 centimetres, and are firm to palpation. About the hilus of one ovary there are several purplish cystic dilatations which, on section, appear to be thrombosed veins. Springing from the surface of the other ovary there is a red bulging hæmorrhagic body which feels rather solid and is one centimetre in diameter. On section the ovary is firm and presents a smooth, solid, yellowish-gray surface. The hæmorrhagic body has a moderately firm whitish-yellow area in its centre."

Microscopical examination of the latter ovary showed (Figs. 4 and 5) in addition to ovarian stroma and corpora lutea, "a proliferation of chorionic syncytial and Langhan's cells. These occur in large hæmorrhagic areas. There are large multinuclear giant cells of the syncytial type, lying side by side with the large nucleated pale cells of the Langhan's type. Frequent mitotic figures are seen. Loops and knots suggestive of villi are seen." Sections of the other ovary showed no tumor.

Discussion.—What conclusions may one draw as to the etiology of the lesions in our case? There are these possibilities:

(1) *The lesion may have originated as part of a teratoma of the ovary or the liver and then metastasized to the jejunum.* This we consider least likely. After puberty, ectopic chorionepithelioma should be considered teratomatous in origin only where such parts can be demonstrated or where pregnancy can be absolutely excluded. Previous to puberty, de Zalka feels that all cases should be regarded as teratogenous.

(2) *The lesion may have originated in connection with an ovarian pregnancy.* There is no evidence for such an assumption in our case.

(3) *The ectopic lesions arose from malignant degeneration of trophoblastic emboli.* The chorionic elements may have been deposited in the left ovary, liver and jejunum, without there having been a primary uterine tumor; these deposits may have degenerated into multiple tumors or into one tumor with metastasis to the other organs. If the latter is the mechanism we believe the jejunal tumor to be primary because it was the largest and most active of the three growths; it could have reached the ovary in a retrograde manner as does the Krukenberg tumor of the ovary which is secondary to a lesion in the upper gastro-intestinal tract.

(4) *A uterine chorionepithelioma was the primary lesion and, although the metastases ultimately killed the patient, the primary lesion disappeared either by spontaneous healing or by expulsion or by curettage.* Novak and Koff[14, 15] state that complete recoveries have occurred not only after incomplete operations but even spontaneously. This possibility seems the likely one. The "black clots without membrane" passed in 1927 may perfectly well have been a chorionepithelioma.

Literature.—The relative infrequency of malignant tumors of the jejunum and the difficulties encountered in their diagnosis has been sufficiently stressed in such recent papers as those by Rankin and Mayo,[18] Raiford,[17] and Johnson.[9] The latter author reported from Vienna 41,838 necropsies in which 3,585 carcinomata were revealed; 343 of these were intestinal, of which ten were in the ileum and none in the jejunum. Raiford reports from the Johns Hopkins Hospital a series of eighty-two tumors located between the pylorus

and the ileocecal junction and constituting 6.5 per cent. of all of their gastro-intestinal tumors. In his series, eighteen were in the duodenum, fourteen in the jejunum (seven were benign) and forty-three in the ileum; in seven the location was not determined. Forty-six per cent. of his cases were asymptomatic.

The literature on ectopic chorionepithelioma has been scanty, particularly during the past twenty-five years, indicating that its occurrence is rarer by far than its extremely rare uterine prototype. In 1904, Findlay[7] collected twenty cases reported during the previous seven years, chiefly in the German literature, and reported a new case. The vagina was believed to be the primary seat in eleven cases, the uterine muculature in three, the cervix, brain, kidney and labium each in one case; in the remaining three it was not possible to identify the primary growth. Further cases have been reported from time to time, but little has been added to our knowledge of the lesion, even when it occurs primarily in the uterus. de Zalka, in a comprehensive review published in 1928, has collected twenty-six cases primarily in the ovary and five cases primarily in the liver.

Our survey of the literature revealed almost no cases which resemble clinically the presentation in this paper. No report of a similar lesion in the jejunum was found. Nolasco,[13] in 1927, reported the case of a female Filipino, aged twenty, who had aborted a three months' fœtus five months before entry. She complained of fever, abdominal pain and vomiting. Two weeks before entry she passed fresh bloody stools. A clinical diagnosis of typhoid fever with intestinal hæmorrhage was made. At autopsy, six days after entry to the hospital, in addition to chorionepitheliomatous lesions in the lungs, left kidney and liver, an area of ileum, eight centimetres long and ninety centimetres below the duodenum, was found to contain three masses of chorionepithelioma. The genitalia showed no evidence of chlorionepithelioma.

Novak quotes a case in which a woman six months after an operation for ruptured tubal pregnancy showed the picture of severe intra-abdominal hæmorrhage. At operation twelve inches of ileum were resected because of profuse bleeding from intestinal implants of chorionepithelioma. There were also hæmorrhagic implants on the bladder and omentum. No mention is made as to the depth of invasion of the intestinal wall; nor is hæmorrhage into the lumen of the bowel noted.

Lutein Cysts.—A consideration of this subject would be incomplete without brief reference to a frequent accompaniment of both chorionepithelioma and its benign prototype; we refer to the multiple lutein cystic changes first described by Marchand. (Such changes were not observed by us.) Coventry[4] states that these cysts are found with 91 per cent. of chorionepitheliomata and with over 80 per cent. of moles. A much lower incidence is given by the several authors quoted by Novak and Koff, who stress the inaccuracy of the statistics. The majority of investigators hold to the view that the ovarian

changes represent a characteristic response to the exaggerated trophoblastic stimulus associated with choriomatous tumors.

In the light of the newer knowledge following the epoch-making studies of Zondek and Ascheim, and Smith and Engle,[22] this hyperluteinization must be attributed to anterior pituitary principles which are associated with activity of trophoblastic tissue. This relationship is ably discussed by Novak and Koff.

Notes on Diagnosis and Treatment.—The ectopic variety of chorionepithelioma occurs with such extraordinary infrequency that its diagnosis, clinically, can rarely be suspected unless there is some suggestive antecedent history or unless the use of the Ascheim-Zondek[1] test or one of its modifications eventually becomes a routine procedure in cases of tumor or unexplained bleeding, regardless of the system involved. It is obvious that, with a new growth that invades and erodes blood-vessels with such rapidity, bleeding from the lungs, gastro-intestinal or genito-urinary tracts will occur relatively early in the active stage of the disease.

Since these tumor-cells are of an embryonic, anaplastic and undifferentiated character, it would be reasonable to expect chorionepitheliomata to be highly radio-sensitive. Schmitz and Hueper[19] report success in two cases of *uterine* chorionepithelioma treated by X-ray therapy alone; also four cases treated successfully by combined treatment (surgery plus X-ray treatment). These authors advocate combined therapy, admitting that the number of cases successfully treated by irradiation is too small to warrant any positive conclusions. Our patient reacted so severely to deep therapy that we were unable to give optimum dosage; what dosage she did receive apparently had not the slightest therapeutic effect.

In general, the treatment in cases of *ectopic* chorionepithelioma has had little influence on a mortality of practically 100 per cent. From the aforementioned work of Fränkl and from the newer knowledge of the interrelationships of the ovarian, placental and pituitary hormones, there is a faint suggestion that the treatment may some day be non-surgical, *i.e.*, it may consist of the use of anterior pituitary or other endocrines, alone or in combination, and transfusions of blood from pregnant women.

Once the diagnosis of ectopic chorionepithelioma is made, the treatment, in the light of our present knowledge, should be radical surgery when possible, supplemented by high voltage radiation. Even if metastases are present, radical surgery, when possible, is indicated because regression of metastases has been observed in such cases.

SUMMARY AND CONCLUSIONS

(1) A case of ectopic chorionepithelioma with lesions in the jejunum, liver and ovary is reported. The etiology of the lesions in this case is discussed.

(2) The literature dealing with the etiology of ectopic chorionepithelioma in general is summarized.

(3) The diagnosis of chorionepithelioma, uterine or ectopic, merits consideration in every case of unexplained bleeding in a woman.

(4) The combined use of radical surgery and high-voltage radiation is advocated.

(5) The use of the Ascheim-Zondek test in diagnosis and prognosis, and the use of radiation in treatment comprise most of what is recent advance in our knowledge of the subject.

(6) The experimental use of endocrine therapy and transfusions of blood from pregnant women is suggested.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD NOVEMBER 23, 1932

The President, Dr. John Douglas, in the Chair

SUPPURATIVE CHONDRITIS OF COSTAL CARTILAGES

Dr. John H. Morris presented a man who at fifty years of age contracted a virulent Type I bronchopneumonia in February, 1931. Bases of both lungs were involved and treatment included appropriate serum therapy. After a stormy four weeks' course symptoms abated somewhat, but continued low-grade temperature, together with persistent signs of solidification below the angle of the right scapula, led to X-ray investigation. Left lung presented unresolved areas of pneumonitis in middle lobe and hilus while in the right there was suggestion of encapsulated fluid in region of the oblique fissure between upper and middle lobes. Thoracentesis yielded only a small quantity of thin serosanguinous fluid. There was little change in this picture up to May, when he developed an abscess of left deltoid muscle from which a pure pneumococcus culture was obtained. Late in May acute symptoms had completely subsided but upon discharge from the hospital the patient complained of pain and tenderness over the costal margin just to the left of the sternum. Early in June he consulted a surgeon, while in another city, because of tender swelling in the region of this pain. Immediate operation carried out at this time was described as "incision of abscess and scraping of rib." He came under Doctor Morris's observation again six weeks later at which time there was a well-organized fistula at site of healed operative wound. Operation was again advised and on this occasion the fistula was widely excised and its source explored. A circumscribed area of osteomyelitis was found at the sternal end of the sixth rib just beyond chrondro-costal junction. It was confined to osseous tissue; the cartilage itself was perfectly healthy. Four inches of sternal end of osseous rib were removed with periosteum, and corresponding cartilage with a small piece of sternum was included. The character of the cavity seemed to permit primary closure and wound was closed save for small rubber tissue drain at outer angle. The wound healed rapidly but, when about completely closed, recurrence of old sinus was evident. In October, 1931, operation was again undertaken; old scar and fistula widely excised down to pleura at site of former excision. Fifth costal cartilage was also exposed and, although appearing grossly healthy, was removed. All necrotic material, including bone, laid down since previous operation were carefully removed to leave a clean cavity. The wound was then packed wide open and permitted to close by secondary granulation. By January, 1932, the area had completely closed in but the original sinus had again reformed.

At this time another culture from the sinus disclosed pneumococcus Type I. A guinea-pig injected at this time with wound material was subsequently reported normal and free from evidence of tuberculosis.

Dr. Alexis V. Moschcowitz stated that when he read a paper upon this subject in 1918 before the American Surgical Association, he reported several cases of suppurative chrondritis caused by various organisms. In that paper, he volunteered the statement that on account of certain inherent anatomical qualities of the cartilage, principally lack of blood-vessels, suppurative diseases of the cartilage do not heal well. He therefore advised that the entire involved cartilage be extirpated so that at the termination of the operation no cartilage shall be visible in the wound.

He now wished to modify the statement inasmuch as one case of suppurative chondritis had healed without any radical operation. As a general rule, however, the dictum still holds good that it is best to extirpate the entire involved cartilage and he is of the opinion that eventually this will have to be done in the case presented by Doctor Morris.

Dr. Frank B. Berry said that he had seen a number of cases of tuberculous chondritis on the Tuberculosis Service at Bellevue Hospital and he agreed with Doctor Moschcowitz that in order to effect a cure it is necessary to do a radical operation. In most cases it seems likely the disease starts in one of the lymph-glands of the anterior mediastinum. There are cases, however, in which radical operation cannot be done. He saw such a case today. The patient has osteomyelitis coming through the middle of the sternum and in order to remove the cartilage, it would also be necessary to remove a large segment of the entire sternum, which seems hardly justifiable. That is the only case of its kind that the speaker has seen. Most of them come through one of the margins and one can close such a case by radical operation.

Dr. John Douglas said he could add a case to those which led Doctor Moschcowitz to retract his previous statement. It was that of a patient shown before this society seven or more years ago in whom the common bile-duct had been repaired following a very bad infection. There had been extensive destruction of the costal cartilages from the original infection. After awhile the wound healed up without a secondary operation to remove the cartilages, only some curettage being done.

Doctor Morris rejoined that in his case it was demonstrated there was no tuberculosis. The man had pneumococcus bacteræmia. It is important to make that distinction here. In Doctor Moschcowitz's series two were tuberculosis and one was actinomycosis. The speaker has received personal communications of cases here in town which have been in New York hospitals in the last few months. Two of these were traumatic, requiring radical excision of the cartilage, and cure had apparently followed this procedure.

POST-OPERATIVE FISTULA OF LARGE GUT. TREATMENT BY IRRADIATED PETROLATUM

Dr. Morris presented a woman, nineteen years of age, who was admitted to Fourth Surgical Division, Bellevue Hospital, May 13, 1930. December 2, 1929, she suffered a spontaneous miscarriage at the third month, following which she was twice curretted for uterine hæmorrhage. In February,

1930, she developed lower abdominal pain and was operated upon for pelvic tumor which was said to be inoperable and abdomen was closed after simple exploration. Recovery from operation was uncomplicated but before discharge from hospital a sinus had developed in the operative wound and this sinus has discharged foul pus up to time of admission to Bellevue. Previous history was entirely negative as regards illness or operations. She was well-nourished and did not appear acutely ill. Vaginal examination revealed a large, fixed, tender mass on right side of pelvis with normal-sized uterus pushed to left. Mid-line suprapubic abdominal scar presented a well-organized fistula leading deep into pelvis.

May 22, 1930, her abdomen was opened through the old scar, following the fistulous track to a chronic inflammatory mass involving right adnexa and right broad ligament. Mass freed by blunt dissection and removed together with fundus of uterus. *Pathological report.*—Tuberculous salpingitis.

The post-operative course was stormy with temperature elevation, distention and vomiting. On eighth post-operative day the wound, which was badly infected, broke down and required secondary suture under general anæsthesia. Two and one-half months later, after wound had completely granulated in, a fæcal fistula developed at its mid-point. During the ensuing twelve months this fistula resisted the conventional methods of treatment such as cauterization with carbolic, curretting, *etc.*, and it was finally decided in view of the patient's general improvement, to again attempt excision.

As a last resort, however, it was decided to try injections of irradiated petrolatum. This treatment was started September 15, 1931, and six treatments at three-day intervals were given, following which fistula closed and has remained so up to date.

RETROPERITONEAL HERNIA COMPLICATED BY VOLVULUS AND GANGRENE OF CÆCUM AND ASCENDING COLON

Dr. Morris presented a man, thirty years of age, who was admitted to the Fourth Surgical Division, Bellevue Hospital, May 8, 1924, complaining of acute abdominal pain and vomiting. The immediate attack began shortly after dinner on the evening preceding admission to the hospital when the patient was taken with an acute, severe pain centring about the umbilicus. The pain rapidly became generalized and by 10:30 P.M. he became nauseated and began to vomit. By 4 o'clock next morning these symptoms became so severe that he was brought to the hospital.

His antecedent history was irrelevant save for the fact that during the previous five years he had experienced a great deal of chronic indigestion in the form of anorexia, nausea and epigastric distress after food. On several occasions there had been definite attacks of epigastric pain which came on about one hour after eating and from which he was able to secure relief by taking sodium bicarbonate. He had been severely constipated for several years.

On examination he presented a picture of acute distress with anxious facies and grayish pallor of skin. His pulse was extremely rapid and was of very poor volume and quality. The abdomen was greatly distended, very tender to palpation and presented general board-like rigidity. Free fluid could be detected in the flanks. Rectal temperature, 98.6°; white blood cells, 27,000; polymorphonuclears, 96 per cent. The presumptive diagnosis was perforated duodenal ulcer.

The abdomen was opened through a right-rectus incision evacuating a large amount of blood-stained fluid. On spreading incision a peculiar picture was revealed, the small intestine having apparently disappeared from

the peritoneal cavity. In the left posterior gutter and occupying the entire rectangular space mapped out by the left half of the transverse colon above the descending colon and sigmoid to the left, the pelvic brim below and the lumbar spine mesially there appeared a globular tumor about the size and shape of a football covered by posterior peritoneum over which coursed numerous vessels giving the tumor the appearance of a large ovarian cyst. The stomach and transverse colon were pushed high up under costal margin and the descending colon and sigmoid were displaced well over to the left. The hepatic flexure and adjacent portion of the ascending colon were in their normal relations but at its mid-point the ascending colon turned acutely towards the tumor mass and disappeared therein through an orifice low down in right side. Shining through the glistening membranous covering of the tumor intestinal coils could be made out and in addition thereto a dark hæmorrhagic mass.

Posterior peritoneum incised over the tumor in avascular area and a 26-inch segment of gangrenous ileum and ascending colon delivered into general peritoneal cavity. This segment resected and end-to-end anastomosis established between ileum and colon. After completion, however, a hæmatoma was observed in root of mesentery opposite anastomosis and as an additional safety factor, a rapid side-to-side anastomosis, ileum to ascending colon, was made to short-circuit this area. Intestine was then returned to retroperitoneal space and posterior peritoneum closed. Attempts to reduce hernia were considered unwise because of condition of patient and abdomen was closed without drainage.

The patient made a good recovery and was discharged from the hospital on the twenty-fifth post-operative day. He has been under observation since operation and with exception of epigastric distress, gaseous distention and fullness after meals, has remained perfectly well to date.

Dr. Bradley L. Coley said that retroperitoneal hernia is still rarely seen. In 1924, Short was able to collect only thirty-eight cases in the medical literature up to that time. Of these, fifteen were of the left paraduodenal type, similar to the one which had just been shown. In 1928, the speaker had occasion to look up the literature and found an additional seven cases of left paraduodenal hernia, and reported a case of his own.*

Doctor Coley's case was admitted to Bellevue Hospital, Second Surgical Division, October 26, 1926, with a history of attacks of abdominal pain, of cramp-like character, associated with obstipation, and frequently with vomiting, which had persisted over a period of twenty years. Six months prior to his admission he was seized with a particularly severe attack, and at that time X-ray studies were advised, but not made. On admission to Bellevue Hospital he was acutely ill and was operated upon under a diagnosis of acute abdomen, the exact nature of which was uncertain. At operation a large tumor was found, similar to the one described by Doctor Morris and containing about four feet of markedly hypertrophied small intestine, at one point of which a beginning intussusception was found. This is of interest in view of the findings in Doctor Morris's case of volvulus, and in both instances may be explained on the basis of a hyperperistalsis.

* Strangulated Left Duodenal Hernia, Archives of Surgery, March, 1929, vol. xviii, pp. 868–881.

The speaker called attention to the importance of not dividing the neck of the sac, which in left paraduodenal hernias contains the inferior mesenteric vein. He was able by traction and taxis to reduce the contents after blunt dissection had elongated the neck of the sac without damaging the vessels. The marked hypertrophy of the contained intestine was striking and suggested a long-continued effort to keep up peristaltic action in the face of mild and intermittent obstruction.

CARCINOMA OF STOMACH. SUBTOTAL RESECTION

Doctor Morris presented a man aged fifty-three, a laborer, who was admitted to the Fourth Surgical Division of Bellevue Hospital, June 8, 1931, complaining of digestive symptoms of ten years' duration, which had consisted of "heartburn," epigastric distention, and eructations coming on about three hours after taking food. Two months before admission he began to vomit irregularly after meals. He has never noted any associated pain. During the past year he has lost 10 pounds in weight. He has never vomited blood or noted dark-colored stools. Venereal history negative and there was no history of any previous illness. He was a pallid, cachectic, dehydrated male of fifty-three. Abdomen scaphoid type but no abdominal tumor was palpable. General examination negative except for presence of small, hard, discrete mass in right lobe of thyroid gland. Wassermann negative; red blood cells, 4,670,000; hæmoglobin, 75 per cent. X-ray reported "neoplastic infiltration of pyloric region with 40 per cent. six-hour residue."

Operation under spinal anæsthesia disclosed pyloric mass adherent to pancreas posteriorly and extending well up into body of stomach. Liver was not grossly invaded but several large glands were noted in gastrohepatic omentum. Mass resected widely and a retrocolic anastomosis of polya type carried out without clamps. *Pathological report.*—"Adenocarcinoma of stomach."

He made a good recovery and was discharged from hospital one month after operation symptom-free. At subsequent follow-up clinics, however, he complained of the regurgitation of small amounts of fluid soon after eating. Appetite remained good, there was no pain or indigestion, and he progressed in weight. Regurgitation continued in spite of careful dietary régime. Total gain in weight since operation 20 pounds.

February 8, 1932, X-ray shows normal functioning stoma with no evidence of recurrence. Gastric analysis (fractional) at this time showed no free hydrochloric acid or lactic acid. Total acidity as high as 50. Occult blood positive.

Case II.—Man, aged forty, was admitted to Fourth Surgical Division of Bellevue Hospital, November 22, 1931.

Up to one month before admission he had enjoyed perfect health and had never experienced any type of gastric disturbance. About this time, however, he began to complain of a dull, burning pain referred to the umbilical region, coming on immediately after the taking of food and always relieved by vomiting. At irregular intervals he suffered from severe vomiting attacks which appeared to be unrelated to food, and on one occasion vomitus was said to have contained blood. Between these attacks there was pronounced epigastric distention and belching of gas. During the past month he had lost progressively in weight (15 pounds) and strength.

In the epigastrium just to right of mid-line there could be felt a hard, irregular, fixed mass about the size of a large orange. The chest presented an area of flatness over base posteriorly and there was systolic murmur over

aortic region of heart. Physical examination otherwise negative. X-ray reported a "persistent deformity of prepyloric region characteristic of neoplastic infiltration."

Operation preceded by whole-blood transfusion was carried out under spinal anæsthesia. Pathology consisted of an annular mass extending from the pyloric vein well into the body of the stomach. No evidence of gross involvement of the liver but there were several enlarged, hard, subpyloric glands. Stomach mobilized, growth widely resected and retrocolic anastomosis of polya type carried out without clamps. *Pathological report.*—Adenocarcinoma of stomach.

Post-operative course uneventful. Temperature and pulse rate normal on third post-operative day. Discharged from hospital on eighteenth post-operative day.

This patient has been entirely symptom-free to date, has enjoyed an excellent appetite and has made a total gain in weight since operation of 35 pounds.

ACUTE APPENDICITIS WITH THROMBOSIS OF MESENTERIC VEINS. EXCISION OF VEINS

Dr. Percy Klingenstein presented a man, twenty-seven years old, who was admitted to Doctor Lewisohn's service, Mt. Sinai Hospital, with the following history: Twenty-four hours before admission he was seized with epigastric pain, which localized in the right lower quadrant of the abdomen twelve hours after onset, and had been persistent since then. There was associated nausea and vomiting; a temperature of 104° He volunteered that prior to admission he had had three shaking chills, one lasting about three minutes, during which his teeth chattered. The other points in the history were irrelevant.

Abdominal palpation revealed exquisite tenderness over McBurney's point; spasm over the right lower rectus, release tenderness over the lower abdomen, with a sensation of mass on deep palpation over the appendix area. Differential blood count showed 24,000 white blood-cells, of which 89 per cent. were polymorphonuclears.

Exploration through a Kammerer incision revealed a medially situated gangrenous appendix. Its mesentery was hæmorrhagic and swollen. After mobilizing the appendix it was noted that emanating from the caput coli, extending around to its undersurface and then upwards and medially, there were a series of black streaks running parallel and then converging, which were about the size of the lead of a thin pencil and with very much the same appearance. These streaks were interpreted as veins, the seat of an acute phlebitis with possible thrombosis. The appendix was ablated after removing the meso-appendix widely and permitting the vessels to bleed freely and ligating these individually. The inflamed veins were then dissected out by freeing the cæcum and turning it upwards. This was effected by dividing the posterior parietal peritoneum at its outer and inferior margin although in part the cæcum was mobile. These veins were excised with the cellular tissue surrounding them, until free bleeding from the divided vessels was noted. This occurred at about the junction of the ileocæcal with the ileocolic vessels. The abdomen was drained with rubber dam at the point where the retroperitoneal space was invaded. The patient made an uneventful recovery except for a rise of temperature to 102° on the sixth, eighth and ninth post-operative days in conjunction with a chilly sensation on the first of these.

The specimen showed acute phlegmonous appendicitis with an acute inflammation of the mesentery in which numerous thrombi in the veins in

combination with an endarteritis could be demonstrated. The excised retrocæcal veins revealed an acute phlebitis. The vessel wall microscopically showed marked evidences of acute inflammation, breaking up of the internal elastic membrane with infiltration of the vein wall with numerous leucocytes. Cultures of the excised veins showed *B. coli.* No bacterial stains on these veins were carried out.

Colp,* in 1926, on the basis of an analysis of upwards of two thousand cases of acute appendicitis in all its forms, with particular reference to the significance of chills came to a series of conclusions, one of which states: "When a chill is present the possibility of pylephlebitis should constantly be borne in mind, and the appendicular mesentery should be carefully investigated for evidences of suppurative phlebitis." Thalhimer† previously cautioned likewise. Doctor Klemperer, pathologist of Mt. Sinai Hospital, tells me that in about 10 per cent. of the cases of acute appendicitis thrombi are noted in the veins of the mesentery of the appendix. The incidence of pylephlebitis is approximately 3/10 of 1 per cent. It is at once obvious that phlebitis in the mesenteriolar veins does not necessarily presage an ascending venous phlebitis. The writer would not want it understood in view of this fact, as his reason for presenting this patient, that he was an adherent of the more radical venous ligations in cases of suppurative appendicitis whenever accompanied by chills. The case presented must be relegated to a slightly different category inasmuch as the process had extended beyond the anatomical limits of the mesentery and was so readily demonstrable. He did not wish to leave the impression that this result falls in the general class of *post hoc ergo propter hoc.* He did wish to call attention to the general principle as exemplified in this case, namely that when the lesion is found, and it should be sought for, and when the procedure, as here, can be carried out without detriment to the patient, it is well worth while.

Dr. Harold Neuhof said that there have been many experiences with cases in which chills accompanying severe appendiceal lesions have been secondary to phlebitis of the vessels of the mesenteriolum and in which local excision of the diseased appendix has not sufficed to cure the patient. On the other hand, there are cases in which phlebitis was undoubtedly present and left behind by simple removal of the appendix and in which the patients survived. Perhaps because of drainage into the liver the clinical course of cases of phlebitis in the distribution of the portal vein is apt to be different from that of phlebitis involving veins that drain into the general systemic circulation.

Dr. Ralph Colp said that thrombosis of the ileocæcal veins in cases of acute appendicitis with chills bears an important relationship to the occurrence of portal pylephlebitis. Dr. A. Gerster first suggested incision and drainage of these thrombosed veins in acute appendicitis, and subsequently Wilms advised excising the involved veins of the ileocæcal angle. However, it must not be forgotten that this procedure might result in a cæcal fæcal fistula. For this reason Braun suggested ligating the ileocolic vein in those cases in which the pathology at the time of operation and the clinical history suggested the possibility of pylephlebitis.

* Colp, Ralph: Annals of Surgery, vol. lxxxv, p. 257, Fed. 1927.

† Thalhimer, William: Arch. Surg., vol. viii, p. 658, March, 1924.

This procedure is not difficult because the thrombosed vein can usually be felt as a cord running upward from the cæcum toward the mesentery to the right of the spine. If, however, the infection has already spread beyond the ileocæcal vein, very little can be gained by the ligation of the portal vein as suggested by the experimental work of Neuhof. This portal vein was ligated in three cases of portal pylephlebitis at Mt. Sinai Hospital, New York, and while the patients did not die from the effect of ligating the vein, they did die as a result of liver destruction due to infected emboli already present in the liver at the time the vein was ligated.

TREATMENT WITH IRRADIATED PETROLATUM

CASE I.—*Pleural Fistula Following Operation for Chronic Empyema.*—DR. HOWARD LILIENTHAL presented a woman about twenty-eight years old, who had been operated upon for chronic empyema which began at the age of four and which then healed. She had been first seen by the reporter November 11, 1929, when there appeared to be a sacculated empyema connecting with a bronchus; there was blood streaking with expectoration and elevation of temperature. She was operated upon by another surgeon who drained the cavity thoroughly but in spite of this the wound refused to heal and it was suggested that an anterior rib resection for complete thoracic compression should be performed but the patient refused consent because of the deformity which would follow. After this, April 24, 1930, he saw her again when there was an undrained pocket and a thoracic fistula. He operated upon her April 29, 1930, using the electric scalpel. A long incision was made above and another below the sinus, mobilizing the lips of the former wound. With blunt retraction the depths could be explored and he incised the dense membrane which held the lung rigid, peeling away much of the membrane and entering an abscess cavity in the lung which obviously connected with a bronchus.

He closed the wound except for a tiny drainage tube with a rubber valve. By October 22, about six months later, the cavity had greatly shrunken in size, its capacity being only about 5 cubic centimetres. The tube was removed but the sinus refused to close, a small discharging fistula about 4 inches in length remaining. Early in January, 1931, he injected irradiated petrolatum using a very small purse silver cannula the shape of a probe which he carefully worked into the sinus apparently to its upper extremity. Next day the sinus was closed and the patient felt well. Three weeks later it reopened but after one more injection of irradiated petrolatum it again closed and she has remained well ever since.

CASE II.—*Suppurative Tenovaginitis of the Palm.*—DOCTOR LILIENTHAL presented also a woman in her fifties, who was first seen by him in consultation January 24, 1931. She was in good health. Three days before she had pricked the palmar surface of her middle finger over its middle phalanx with a wire. The puncture did not bleed but twenty-four hours later there was pain and swelling which progressed so rapidly that when he saw her the finger was red, swollen and extremely tender and the back of the hand was œdematous. There had been no chills and there were no enlarged lymph-nodes. Temperature was 101.5°. Two hours later at Mt. Sinai Hospital under general anæsthesia a rubber tourniquet having been place about the forearm, and after disinfection with iodine, he made a small but deep incision over the puncture mark on the volar space of the middle phalanx. No pus was found. Two sagittal incisions were then made through the

tissues over the proximal phalanx, one at each side of the tendon. About 10 cubic centimetres of thin pus were evacuated, coming from the distal part of the incision. The tendon sheath was freely opened but no pus was seen coming from the region of the palm, only from the distal part of the finger. The wounds were filled with warm, liquid, irradiated petrolatum and the entire hand dressed with dry gauze and placed on a splint in moderate extension with the fingers partly flexed. There were no packings of any kind and no tube was used. Little pain followed this operation and the wound was not dressed until forty-eight hours later. There was no pus although the proximal wounds were explored by a probe but there was still œdema of the back of the hand and slight tenderness in the palm. The parts were cleansed with ether and the hand and arm immersed in a saturated solution of magnesium sulphate. The temperature did not rise higher than 99° and the pain was trivial.

January 28, 1931, four days after the first incision, with the same technic, he made an opening ¾ inch long through the palm in the line of the tendon, evacuating a little opalescent serum from the sheath which was freely opened. The wound was filled with irradiated petrolatum as at the former procedure. At this time the earlier wounds were separated with dissecting scissors for purpose of examination. The laboratory had reported streptococcus hæmolyticus from the specimen sent at the former operation. The short course of the after-treatment was without incident. Finger exercises were begun two days after the last procedure. Healing was rapid and complete with 90 per cent. or more of function.

He had never seen an infection of this kind yield so promptly and feels that the treatment by the irradiated petrolatum was of prime importance.

Case III.—*Tenovaginitis of Anterior Tendons of Foot and Leg. Incision and Drainage.*—As further illustrating the use of irradiated petrolatum, Doctor Lilienthal presented a man, aged about sixty, who was first seen by him March 29, 1931. For a few days the patient had had pain at the anterior aspect of the ankle and two days before he saw him a swelling had appeared, which Doctor Moschcowitz aspirated, withdrawing opalescent fluid diagnosed as coming from a tendon sheath. When Doctor Lilienthal saw him the skin was reddened and there was a fluctuating elevated area about 1½ inches in diameter. No femoral lymph-node enlargement was present and no lymphangitic streaks. Temperature 101°. Because of the rapid progress of the case he operated the same day.

Elastic constriction of the thigh was made so as to have a clear field for operation. Through a sagittal incision granulation tissue was first encountered and beneath this there was a free discharge of pus which proved to have come from the anterior tendon sheaths, especially that of the anterior tibial muscle. It was necessary to prolong the incision upward and downward for nearly 3 inches and a large quantity of opalescent pus was discharged from within the sheath. A specimen for culture was taken. The wound was filled with melted irradiated petrolatum without packing but a piece of gauze was laid upon the wound and held in place by a large elastic compression dressing.

There was immediate relief; discharge was minimal and the patient left for his home a few days after the operation where treatment was continued. Ten days later he was able to come to the office for dressings but the wound healed slowly and he was not discharged until two months after the operation. Still, the man was up and about after three weeks and at no time was there any sloughing, extension of infection, or other complication. The report from the laboratory was pure culture of streptococcus hæmolytic. (Beta.)

These three cases exemplified what he had observed in more than a year of the treatment of septic wounds with ultraviolet irradiated petrolatum.

In chronic sinuses without the presence of a septic foreign body he had had excellent results. In accelerating the healing of draining sinuses following cholecystectomy the petrolatum has been of great value. He had used it with satisfaction in nearly all wounds in which the petrolatum could be retained. Large cavities, however, such as those connected with pulmonary abscesses, had not responded in the striking manner which he had noted in narrower tracts whose ultimate recesses are difficult to reach. He had never seen any bad effects from the use of this remedy. In one case, that of an amputation of the thigh still under treatment, previous intensive therapy by X-ray had produced an indurative condition of all the soft parts which for months had been healing very slowly and in which irradiated petrolatum has been of service only to diminish suppuration. It did not seem to have hurried the actual obliteration of the infected cavity nor had any other agent been more successful. At present there is continuous and great improvement.

Petrolatum without irradiation has long been used in septic wounds of surgery. In the early days vaseline and cosmoline were used for almost every kind of dressing. The mere fact that it has been almost discarded seems to be an indication of failure while the applicability of the irradiated variety seems to be constantly increasing.

The two cases of acute infection of the tendon sheaths by hemolytic streptococcus are remarkable examples of what has been accomplished. He did not remember ever to have seen infections of this type eradicated with such speed and with so little reaction.

The material is non-poisonous while other direct antiseptics may produce toxic symptoms in subjects who have idiosyncrasies. Cleansing the wound with ether before instilling the petrolatum adds to its efficiency. A flexible metal cannula of very small size attached to a hypodermic syringe is a convenient instrument for this purpose.

Doctor Eising has written on the physics and chemistry of irradiated oils and his contributions may be consulted by those who seek full information.* †

Dr. Eugene H. Eising (by invitation) said that the physical, chemical and bacteriological aspects of irradiated petrolatum were of great interest but that he would confine his discussion to the clinical side of the cases presented. He believed that the cases which he had treated together with those reported to him either verbally or in writing, as having been cured, numbered close to two thousand. In regard to the case of chondritis of the rib

* Eising, E. H.: Therapeutic and Physical Properties of Ultraviolet Irradiated Petrolatum. Annals of Surgery, vol. xciii, No. 6, pp. 1231–1253, June, 1931.

† Eising, E. H.: Ultraviolet Irradiated Petrolatum—Its Physio-chemistry and Bacteriology. Med. Jour. and Rec., vol. cxxxvi, No. 6, pp. 251–253, September 21, 1932.

reported by Doctor Morris, quite a number of such cases have been reported cured by injecting liquefied irradiated petrolatum into the sinus. Occasionally, this must be repeated two or three times; it is essential that the entire sinus be filled and that no air bubble be left at the extremity of the sinus. Doctor Morris will probably effect a cure by persisting in this method. Doctor Morris's case of abdominal fistula is quite similar to the first case in which he used this material. Doctor Lilienthal's case of suppurative tenovaginitis of the finger and palm was the first case to be treated in that manner at the time of operation. He felt justified in asking Doctor Lilienthal to treat this case by flooding the open tendon sheath with warmed irradiated petrolatum, because he had previously treated a traumatic case, in which, following an automobile accident, the palm of the hand was laid open and the tendon sheaths exposed. This case had been sutured and subsequently became infected. The entire wound had to be opened and irradiated petrolatum was flooded into the wound. The infection cleared up at once and there was no extension of the infection. This case demonstrates the bactericidal action of this material. The bactericidal action and stimulation to granulation are also well demonstrated in large abdominal wounds that have broken down after laparotomy. These purulent wounds may be flooded with irradiated petrolatum and covered with gauze. At the second, third, or sometimes fourth application, the wound will be entirely free from discharge and can be closed, in bed, with a few silkworm sutures. Many weeks of convalescence may thereby be saved and result in a much stronger abdominal wall than would have resulted by healing by granulation.

Dr. William Bierman (by invitation) said that about two years ago Doctor Eising asked him to analyze this product. At first it appeared as if whatever clinical value it had was due to some ultraviolet irradiation. No ultraviolet irradiation, however, could be found. It fogged a photographic plate but if the petrolatum was covered with quartz glass this did not occur. This indicated there was no irradiation which could go through quartz. The therapeutic effect was due to some change in the jelly produced by the irradiation. It is certain that there occurs some chemical change in the substance as a result of ultraviolet irradiation.

COMMON BILE-DUCT INJURY WITH IMMEDIATE REPAIR

Dr. Seward Erdman presented a man, aged sixty years, who was admitted to the Medical Service of the New York Hospital, March 12, 1932, with a history of over one year's duration of epigastric distress, "heart burn," gaseous eructations chiefly soon after meals. For the past two months the pain had become much more severe and persistent, no longer related to meals nor relieved by sodium bicarbonate. There was occasional vomiting, loss of weight and strength, dizziness and sallowness of the skin.

Sixteen years ago, with a somewhat similar train of symptoms, he had been under medical treatment for "gastric ulcer" (?) and had been relieved by several weeks of rest and ulcer diet. In March of this year he was put on a Sippy diet but failed to improve and after ten days, developed severe epigastric pain and tenderness, with chill and fever of 105°. Irregular chills and a temperature of 101° to 102° continued for about two weeks.

X-rays of the gastro-intestinal tract were negative. The gall-bladder failed to visualize with the dye test. Icterus index was from 13 to 19. Leucocytes, 14,400; 88 per cent. polymorphonuclears.

Operation, April 12, 1932.—A small very much thickened gall-gladder was found high up under the liver, completely covered with dense omental adhesions. Four facetted gall-stones about 1.5 centimetres in diameter were in the gall-bladder. The gall-bladder was removed, beginning at the fundus, because the ducts were buried. The proximal half of the gall-bladder was embedded in almost leathery adhesions in the liver bed, due, as the specimen showed, to an old perforation and suppuration in the liver bed. Sharp dissection was required to separate the gall-bladder from this part of the liver bed. During this procedure the hepaticus was unwittingly cut across. As this was not recognized at the instant it was natural to assume that the small remaining stalk of the now completely free gall-bladder was the cystic duct, and this was now ligated and divided. Inspection of the depths of the wound, however, showed bile flowing freely from the open end of the hepaticus which had been cut across obliquely. The ligated end of the common duct lay fully 2½ centimetres distant.

After such mobilization of the common duct as was possible, an end-to-end suture of the ducts was made over a T-tube, using seven interrupted sutures of No. 00 chromic catgut. The wound healing and the convalescence were rapid and the stools showed bile until the tenth post-operative day, when all bile came out through the tube and the stools were acholic.

Attempts to relieve the obstruction by clamping the tube merely caused cramps and leakage around the tube. Syringe injections and attempts to insert filiform bougies were alike unsuccessful. On the twenty-eighth day a lipiodol injection was made and the X-rays revealed that no fluid passed beyond the limits of the distal end of the T. The patient was sent home for a month, with a complete external biliary fistula.

Upon readmission to the hospital in June, it was felt that simply drawing out the T-tube would hardly suffice to relieve a common-duct obstruction which had persisted more than 2½ months. June 24, 1932, a second operation was performed and the ducts explored, and found to present a smooth and completely healed union, except for the round hole through which the T-tube had its exit.

The tube was withdrawn, and the distal portion found filled with a thick brownish mud. The duct distally contained some of this same material but admitted a probe through into the duodenum. A very small tube was now placed in the hepaticus for a few days, after which leakage occurred into the dressings until the twentieth day when the wound became dry and rapidly and permanently closed, and the stools became normal in color.

Up to the present the condition of the patient has been perfectly satisfactory, but it is much too early to feel sure that stricture may not occur at the site of the anastomosis.

The blockage of the duct while the T-tube was still in position led to many misgivings as to whether the anastomosis might have given away: nor is it easy to see how one can go about clearing an obstruction in the distal portion of the T without resorting to operation.

This case shows that an end-to-end approximation may be secured by an immediate repair, although the defect measured 2.5 c.m. Merely to bridge over such a defect with a T tube, is more likely to result in cicatricial stenosis of the fibrous channel, thus formed.

Dr. Carl Eggers remarked that in such cases as Doctor Erdman had presented, in which there is a great deal of infiltration with obliteration of normal landmarks, an injury to the common duct is understandable. Injury to the duct, and even complete division, has resulted from operation in very simple cases. Especially since cholecystectomy in a retrograde manner, beginning with ligation and division of the cystic duct, has become the operation of choice with most surgeons, this accident has been reported more frequently. He had had such an unfortunate result in a case about two years ago. The operation was very easy in a thin young woman in whom it was possible to evert the liver and expose the gall-bladder and ducts. He doubly ligated and divided what he believed to be the cystic duct and removed the gall-bladder without difficulty. While ligating the vessels it seemed to him that the strand was rather thick, but on inspection found nothing wrong. There was no bile leakage. The abdomen was closed without drainage.

On the third day the patient became jaundiced and this jaundice increased. The question of ligation of the common duct was considered but dismissed because the stool continued to have normal color. Except for the presence of jaundice, the convalescence was uneventful, and the patient was discharged to the care of her family physician. The tentative diagnosis was hepatitis or ligation of an accessory duct. She remained under the care of her physician and was not seen again for two months when she complained of loss of appetite, tired feeling, and itching of the skin. She stated that her stool was clay colored. Operation was advised and performed three months after the original operation. There were extensive adhesions under the liver which made identification of structures difficult. By mobilizing the duodenum the lower end of the common duct was identified, and it was also possible to free the upper end of the hepatic duct just under the liver. It was much dilated. The mid-portion of the common duct had either been obliterated or was absent. By means of a T-tube a connection was established between the upper and lower ends and the abdomen then closed. On account of excessive oozing during operation a transfusion of 500 cubic centimetres of whole blood was given. Some bile drainage became established, but the patient began to bleed and in spite of all counter measures she expired on the fifth day.

The explanation for such accidents is difficult. It is hard to realize that ligation of the common duct has been done in such easy cases. The most satisfactory explanation is probably the assumption of abnormal duct arrangements. That there is great variation in the arrangement of the ducts is well known. Beaver, of The Mayo Clinic, on the basis of fifty-seven careful dissections, found that only 58 per cent. correspond to what we usually call the normal arrangement. It is the type in which the cystic duct runs parallel to the hepatic or common duct and is bound together with it by a fibrous union, which is most liable to accidental division. It is often almost impossible to separate them and it is conceivable that one may pick up and ligate both instead of only one. The best way to prevent this seems to be by

beginning dissection in a cholecystectomy at the fundus and work towards the cystic duct. This is the method he has followed since his unfortunate experience.

Dr. Howard Lilienthal, to show one thing that can happen, made a diagram upon the blackboard showing how it is possible by traction upon the gall-bladder during its removal to lift the common duct into a sharp angle which makes a Y with the cystic duct, and how this may not be observed by the operator who includes the two legs of the Y in his ligature. If this ligature is of slowly absorbing material dangerous and even fatal jaundice may at once supervene.

Dr. DeWitt Stetten recited the case of a woman, sixty-four years old, with a somewhat thickened gall-bladder, containing a solitary ovoid calculus, and with a fistulous communication between its fundus and the duodenum. After separating the adhesions between the fundus of the gall-bladder and the duodenum and closing the opening in the duodenum, he proceeded in the usual manner to perform a cholecystectomy from above downward. The cholecystectomy was unusually easy. After ligating and dividing the mesentery of the gall-bladder, a rather larger lumen than usual was noted in the ligature and, on removing the ligature, it was found that the hepatic duct had been completely divided transversely just above the entrance of the cystic duct, the accident apparently due to an anomaly that is not uncommon—namely, a parallelism of the cystic and hepatic ducts, under which conditions a division of the hepatic duct can very easily occur. The nature of the mishap was immediately recognized and an end-to-end anastomosis of the divided duct was performed without much trouble and without the use of a tube. A cigarette drain was introduced just below the suture line. The patient made an uneventful recovery with only slight biliary drainage for a short time after the operation. Thirteen years later Doctor Stetten saw her again. At this time she was complaining of what appeared to be a mild attack of cholangitis with slight jaundice and elevation of temperature. She recovered from this under medical treatment and, as far as Doctor Stetten knew, she is still alive and well, eighteen years after the duct injury and repair.

Dr. John F. Erdmann said that all surgeons who have practised for any length of time have had such an experience. Two such accidents had already occurred to him and such an occurrence is distinctly unsettling to the surgeon. He had repaired seven injuries to the common duct in other men's patients with the major portion of them recovering. In the first one in which he had done the after repair the patient died, but this was due to her delay in accepting operative advice. It is not material to him whether he approached the duct from above or below, but it has been his custom in the past ten years to approach it from below. Previously he had advised approaching it from above. Where there is any marked infiltration in the neighborhood of the cystic and common duct removal from above downwards should be the policy.

TETANUS FOLLOWING APPENDECTOMY

DR. SEWARD ERDMAN presented a man, aged thirty, who was operated upon by him at the New York Hospital, immediately after admission, March 21, 1932, for acute appendicitis of less than twenty-four hours' duration. The appendix was found in a stage of early but complete gangrene and was removed without rupture through the McBurney incision.

The peritoneum was closed, but a drain was placed down through the muscles. The post-operative course and healing of the wound proceeded smoothly until the evening of the ninth day after operation, when after chewing gum all the afternoon, he complained of slight stiffness of his jaws, but could open the jaws fully. His temperature had been normal up to this time; the wound was healed save for a small granulating area at the site of the drain; and he was to be allowed out of bed on the morrow.

The patient now recalls that later during the same night he felt some "twitchings" and pain in the region of the wound.

The following morning, he was unable to open his mouth and had difficulty in swallowing fluids; the temperature rose to 101.8°. Leucocytes, 11,000, with 69 per cent. polymorphonuclears. The picture was now that of a full-blown case of tetanus, on the morning of the tenth post-operative day, with tightly clenched jaw, generalized muscular rigidity, with the back arched and the head drawn back in opisthotonus. The abdominal muscles were rigid; the right leg was rigidly extended, while the left leg was held flexed. Clonic spasms of the right lower extremity occurred frequently, lasting for about one and a half minutes, and during these spasms the opisthotonus was exaggerated. For over forty-eight hours these attacks recurred at intervals of from ten to thirty minutes.

Treatment was at once instituted. Within less than fourteen hours from the first complaint of jaw stiffness, a lumbar puncture was performed and ten cubic centimetres of spinal fluid withdrawn, which was clear, containing only three cells (polymorphonuclears) per cubic millimetre. Immediately 10,000 units of tetanus antitoxin were given intraspinally and at the same time 20,000 units intravenously. At six-hour intervals two more intravenous injections were given of 20,000 units each and a subsequent one of 10,000.

Twenty-four hours after the first intraspinal dosage, lumbar puncture was again performed and 20,000 units injected intraspinally. The spinal fluid now was turbid and contained very many cells. Thus at the end of forty-eight hours after the first onset, he had received 100,000 units; *i.e.*, 30,000 intraspinally and 70,000 into the vein. During the following day (third of the disease) he received 20,000 units intravenously. On the fourth day two injections of 10,000 each were made intramuscularly in the area about the appendectomy incision. No serum was given on the fifth and sixth days, but on the seventh, eighth, ninth, tenth and twelfth days he received 10,000 units intramuscularly in the abdominal muscles, and finally on the fifteenth day 1500 units. Thus in total he received 191,500 units of tetanus antitoxin, and developed only a mild serum sickness.

Chloral, sodium bromide and morphine were freely administered but failed to control the spasms.

By the fourth and fifth days, although the trismus, the sardonic grin, the opisthotonus and rigidity continued, the clonic spasms were less frequent and severe, occurring about every thirty to forty-five minutes. At this time he developed severe paroxysms of coughing and cyanosis perhaps from his difficulty in swallowing fluids, and getting rid of mucus. The temperature continued between 100° and 102.5°. After the seventh day definite improve-

ment became evident and the clonic spasms ceased entirely about the tenth day. From the eleventh day onwards there was gradual relaxation of the muscles and the mouth could be opened slightly and convalescence from tetanus seemed assured.

On the tenth day the right parotid gland became swollen and tender, and Stenson's duct was blocked with thick white mucilaginous secretion, not containing pus-cells. Despite efforts to clear the ducts and the application of external heat suppuration set in and six days later two incisions were made near the angle of the jaw, several ounces of pus obtained, and thereafter for ten days there was much discharge of pus and slough, which delayed the convalescence. The patient was discharged on the thirty-second day after the onset of the tetanus. It seems probable that the parotitis may have originated from inspissation of saliva, and blocking of the duct, owing to the lockjaw and the limited and purely fluid nourishment.

At no time were tetanus bacilli recovered from the appendix wound, despite repeated cultures and a limited débridement. The suppurative parotitis pus yielded *Staphylococcus aureus*. Progress after discharge from the hospital was very rapid and the patient gained thirty pounds in weight within two months. He appears now to be perfectly well.

Comment.—The favorable outcome was due in no small measure to Dr. Frank M. Davis, one of the house surgeons, who administered the treatments and devoted himself unstintingly to the care of the patient, Dr. Davis writes "if the enormous amount of serum seemed excessive of theoretical requirements, they did not dare fail to utilize every therapeutic measure available, while the symptoms were so persistent."

Jonathan Wainwright, in 1926, reviewing all cases in British and American literature for the last twenty years, encountered 365 cases of post-operative tetanus, including seventy-eight oöphorectomies; thirty-eight inguinal hernias; thirty-seven appendectomies; twenty-nine hysterectomies and ten gall-bladder operations. Wainwright is stoutly opposed to intraspinal injections, but believes in the necessity of giving from 30,000 to 50,000 units intravenously and intramuscularly, and early. He quotes Friedlander, of Cleveland City Hospital, as giving an initial dose of 78,000 by vein; one patient received by vein and muscle a total of 755,000; three patients received over 600,000 and eight patients received over 200,000 units.

Our patient lived in a truck-farming area of Long Island and worked in his own garden. Is it possible that he harbored tetanus bacilli in his intestinal tract?

Dr. Grant P. Pennoyer stated that post-operative tetanus is fortunately a very rare disease. It has a mortality of about 85 per cent. They had had two cases at Roosevelt Hospital within the past ten years, one following a simple hemorrhoidectomy, the other a mastectomy. The mastectomy was done to get rid of a foul, malignant ulceration. Both these cases died within forty-eight hours after the onset of symptoms despite vigorous treatment. It is the most fatal of all surgical complications. It is so rare that many experienced surgeons have never seen a case, but it does occasionally occur

most unexpectedly after most any operation. The only hope for the patient lies in very prompt recognition and vigorous antitoxin treatment. It usually begins between the fourth and fourteenth post-operative days, never before the second day, rarely after the eighteenth.

The first signs are usually stiffness and perhaps slight pain on motion of the jaw muscles, or perhaps the neck muscles are the first to be involved. This increases slowly in mild cases with a long incubation period, very rapidly in fulminating cases with a short incubation period. The jaws and neck become rigid and soon generalized tonic convulsions follow and usually death. There is usually no fever, no rise in the pulse rate, no swelling or indication of infection, no objective signs of a serious complication developing. The patient's story of a stiff jaw or neck are ignored and the chance for a recovery lost by delay in the onset of treatment. In amputation stumps the disease may be localized to the stump muscles at first and the first signs of the disease may be local twitchings in the stump. Peterson summarized 150 cases collected from the literature and many more have been reported since.

The source of the infection has been much discussed. Catgut and kangaroo tendon have been blamed, and in rare cases proven to be the source. Probably with improved methods of suture preparation this is now rarely the case.

The intestinal tract of the patient is the most probable source. The bacillus and its toxin are harmless in the intestinal tract, but once given entry into the body tissues the situation is very different. Competent observers have found tetanus bacilli in human stools in as high as 5 per cent. of cases, and the incidence in stable workmen may rise to 20 per cent. The appendix stump, the clamped hemorrhoid or merely the traumatized intestinal wall may be the portal of entry. Many of the cases have clean operative wounds and it is impossible to prove the source or location of the infection. Abdominal operations are more frequently followed by tetanus than any other type.

In certain cases there is evidence that tetanus spores have lain dormant perhaps for years in the tissues and were simply activated by the trauma or metabolic changes incident to the operation. The possibility of this must be considered in patients who have had tetanus and recovered.

The rôle of symbiosis with pyogenic and saprophytic organisms which consume oxygen and favor the anaërobic growth of the tetanus bacilli is also, undoubtedly, very important.

There are certain general facts about tetanus which should be borne in mind in a discussion of post-operative tetanus. The disease is more frequent in this region—that is, the Hudson Valley, Long Island and New Jersey and other Atlantic States—than elsewhere in the United States. The spores are the most resistant known. Active bacilli have been obtained without difficulty from a dry nail dipped in a tetanus culture eighteen years before. How much longer the spores will live has not been proven. Spores have been known to survive a whole hour of boiling, and fifteen hours of immersion in 5 per cent. phenol. Hence this disease is not going to disappear.

The toxin is the most virulent poison known. A dose of 1/250 grain of toxin is sufficient to kill a 150-pound man. A case is on record of the mere prick of a needle, which had been dipped in a sterile toxin, filtered free from bacteria, nearly causing the death of a laboratory worker. As the antitoxin is ineffective once the toxin is in combination with the nerve-cells, it is easy to see why the disease is so fatal, except when recognized early.

The treatment of post-operative tetanus is very prompt administration of large doses of antitoxin intravenously and intraspinously, followed by intramuscular injections. Any recognized collection of pus should be thoroughly drained. Antispasmodics, especially chlorotone by rectum, are helpful.

The antitoxin administered is entirely eliminated in ten to fourteen days. If the tetanus bacteria are still active and no more antitoxin is administered, the disease will recur. Cases of late death are reported, after the disease had been arrested by repeated doses of antitoxin, due to neglect of this fact.

Dr. Frank L. Meleney said that on the surgical service at the Peking Union Medical College in China, two cases of tetanus occurred following bed sores and one case developed after a gunshot wound of the abdomen. In these cases tetanus bacilli were found in the stools. This led to a study of the incidence of tetanus spores in the intestinal tract of Chinese patients. TenBroeck found that 37 per cent. of the Chinese patients in the hospital had tetanus spores in the stools. During the recent World War, Tulloch, in England, found that soldiers from the front had an incidence of 33 per cent., while people in cities, not near the soil, had about 3 to 5 per cent. The speaker inquired if any attempt was made to examine the stools of his patient for this organism. This would seem to be the most likely source, but if after careful search they were not found in the stools, the catgut used during the operation would be under suspicion for wound infection with tetanus bacilli from inadequately sterilized catgut has undoubtedly occurred.

Doctor Erdman, in closing the discussion, said that the stools were not examined, although it was assumed that the source of the infection was from intestinal contents. Numerous cultures were made of the wound, which failed to show tetanus bacilli. The patient lives in one of the truck-garden areas and spends all his leisure time on his hobby, which is working in the soil. Tetanus is less common now in cities than it was formerly because automobiles have replaced horses.

HERNIA INVOLVING THE BLADDER. VISUALIZATION BY CYSTOGRAM

Dr. Seward Erdman presented a man, aged fifty years, who was admitted to the New York Hospital, October 9, 1931, on account of bilateral recurrent inguinal hernias, both of which had recurred four times. The first bilateral operation was in 1918 at the Hospital for the Ruptured and Crippled, the second and third repairs were performed at the East New York Hospital, during the following ten years; and the fourth repair, some five months ago at the Beth Israel Hospital, had recurred almost immediately.

Examination on admission showed a moderate-sized recurrence on both sides, larger on the right. The testis on the right side was completely atrophic, but the left was normal in size. Owing to the site of the recurrence on the right side, directly over the spine of the pubis, it was rather to be expected that the bladder might be involved, and suggested that a cystogram of the bladder might be used to confirm this suspicion. A 10 per cent. sodium iodide solution was injected into the bladder and X-rays taken, which showed very definitely a portion of the bladder protruding out through the hernial ring.

In view of the frequent recurrences, it was decided wiser to repair only

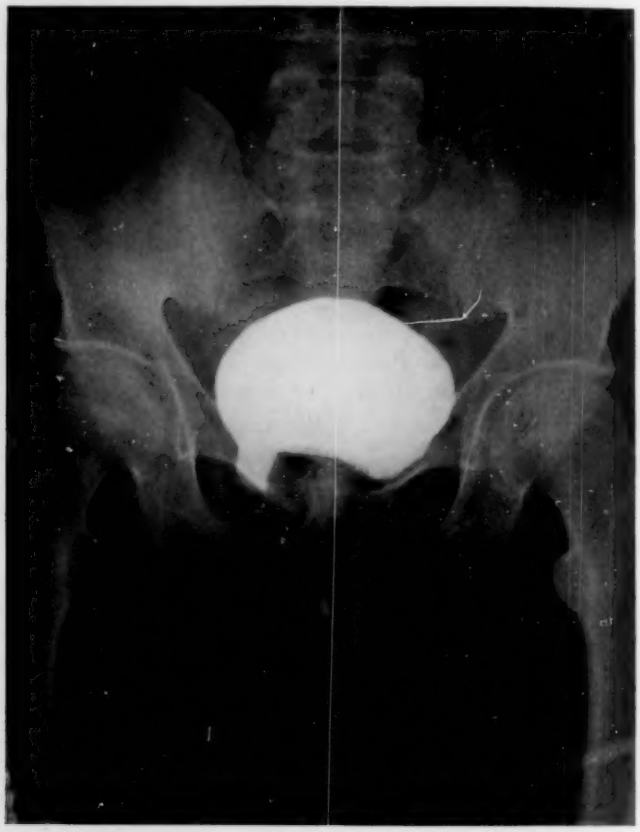

FIG. 1.—Cystogram showing definite protrusion of bladder through the Direct Hernia ring on the right, with merely a bulging into the Left Hernia ring.

the right-sided hernia at this time, leaving the left recurrence for repair at a later date, and indeed, this latter has been only recently done by the resident at the New York Hospital. At operation on the right side, a protrusion of the bladder was found as indicated in the X-ray, and forming a major portion of the hernia. (Fig. 1.) After careful separation from the bladder the sac of the hernia was closed in the usual manner. The hernial ring consisted of a large defect in the aponeurosis and fascial layers directly above the spine of the pubis, a common type of direct recurrence, which I name an "inner angle recurrence." This defect was closed by using three strips of fascia lata for sutures after the Gallie method.

This case was presented merely to call attention to a method of diagnosis, which he had not seen described in the literature, but one which might have a field of application helpful to the surgeon in forewarning him of the presence of the bladder in the hernia and thereby still further limit the instances of unintentional injury to the bladder at operation. In nearly every reported series of hernia operations such injuries have occurred in a number of cases, sometimes with serious if not disastrous results.

Dr. Bradley L. Coley said that the hernias in which the bladder may most frequently be injured are: (1) Recurrent inguinal hernias; (2) direct hernias; and (3) large indirect scrotal hernias. He showed prints of a radiograph of an enormous scrotal hernia in which a cystogram and barium enema were made coincidentally. In this case the presence in the sac of a large part of the colon was established, while the bladder was found not to occupy any portion of the sac. It seemed to him that Doctor Erdman's suggestion of taking a cystogram in these difficult cases of hernia should be more generally adopted, and the presence or absence of this complication established prior to operation. Injury to the bladder, while a not infrequent important complication of the surgical treatment of hernia, is not apt to be followed by serious results, if the injury is recognized immediately and carefully repaired.

THE DIAGNOSIS AND OPERATIVE TREATMENT OF ACUTE PHLEBITIS COMPLICATED BY GENERAL SEPTIC INVASION

Dr. Harold Neuhof read a paper with the above title for which see p. 808.

Dr. Frederic W. Bancroft said that there are some methods which can be utilized in the early treatment of phlebitis before it becomes septic that may prevent the necessity of ligation. The intravenous injection of an aqueous solution of 0.5 per cent. of gentian violet very frequently causes marked improvement. In fourteen cases where this treatment had been used the patient was very definitely improved, as shown by a drop in temperature within twenty-four hours, and in some cases of femoral phlebitis a decrease in size of from one to two inches in circumference of the thigh within two days. About fifty cubic centimetres of this solution is injected and it may be repeated after forty-eight hours if there is no marked improvement. In the cases followed where this treatment has been used there has been very little if any residual swelling of the leg in cases of femoral phlebitis. When the phlebitis has become definitely septic, Doctor Bancroft is thoroughly in accord with Doctor Neuhof's use of proximal ligation followed by excision of the infected vein where it is possible without too great operative shock.

Dr. John H. Garlock stated that most surgeons would agree with Doctor Neuhof regarding the necessity for surgical intervention in septic phlebitis and thrombophlebitis. This condition is to be sharply differentiated from the ordinary post-operative phlebitis of the femoral vein, which, in the majority of instances, is a non-surgical condition. That a septic infection of a

vein may present a rapidly fulminating course and end fatally in spite of early recognition and early surgical attack is evident in the following case:

This patient was seen in consultation six days after her injury, which consisted of a small laceration over the anterior aspect of the proximal phalanx of the right index finger. An infection developed which was incised under general anæsthesia by the attending physician. The infection seemed to be definitely under control, when suddenly, exactly thirty-six hours before the patient was seen by the speaker, she experienced a shaking chill followed by a rise of temperature to 106° F. During the following twenty-four hours, she experienced repeated chills and the temperature assumed a septic course. Examination revealed a partially healed incised wound on the anterior aspect of the base of the right index finger and a slight barely perceptible tender thickening along the inner aspect of the arm just above the elbow. Her blood culture revealed innumerable colonies of *Staphylococcus aureus*. Operation was undertaken immediately on the assumption that the condition was one of septic thrombophlebitis of the brachial and axillary veins. Through an adequate incision, the axillary vein was exposed and explored peripherally as far as the wrist. The entire venous system on the mesial aspect of the arm and forearm was the seat of an extensive thrombophlebitis. The veins were filled with a purulent thrombus. A careful dissection was done, excising the main veins and all their tributaries. The axillary vein was ligated about an inch and a half above the thrombus. Free bleeding occurred above this point. In spite of this radical operation, the patient continued to go downhill and died four days later. Autopsy showed multiple embolic abscesses confined mainly to the lungs.

Such malignant course in the presence of septic thrombophlebitis is unusual, and early surgical attack, in most instances will result in the cessation of the symptoms due to septic invasion of the blood-stream.

Dr. Frank L. Meleney called attention to the rather low percentage which Doctor Neuhof had given for the incidence of infected thrombi found at autopsy in cases of septicæmia. In the wall of any abscess there are thrombosed vessels and the thrombosis may extend out into larger venules and finally involve tributaries of the large veins. The difference between a simple abscess and an infection with septicæmia would seem to be one of degree of involvement of thrombosed veins or thrombosed lymphatics. If a septicæmia is maintained, organisms are being thrown off into the blood-stream in greater numbers than the blood can kill off, for it is known that organisms in great quantity are destroyed in the blood-stream or removed from it by capillary phagocytosis. May not a septicæmia be maintained by a multiplicity of small vein thromboses as well as by a single large suppurative thrombosis? It would seem that if a search were made in cases of septicæmia for small suppurative thrombi that they would be found in almost every case.

Further, there seems to be a difference of opinion regarding the time and site of vein ligation in cases of suppurative phlebitis. It would seem to be more logical and more safe to ligate the vein first as high up as it may be done conveniently and work down toward the infection rather than to work up from the infection along the involved vein.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD NOVEMBER 7, 1932

The President, Dr. John Speese, in the Chair

Calvin M. Smyth, Jr., M.D., Recorder

PLASTIC OPERATION OF NECK, LIP AND AXILLA

Dr. George M. Dorrance presented a boy who was admitted to St. Agnes' Hospital eight years ago. He was then four years old, and had been burned over the side of the abdomen and chest. At the time of admission he had almost complete eversion of the lower lip, with the chin pulled down to the upper end of the sternum by scar tissue which was thick and keloid in type. The lower eyelids were partially everted by the pull of the neck. The little finger of the left hand was flexed upon the palm, and on the ulnar surface of the hand there was a mass of scar tissue. The left axilla had a web contracture.

The first operation consisted of freeing the chin from the sternum by dividing the scar tissue. When the chin was freed, a large denuded area resulted and this required skin covering. To accomplish this, a flap was raised from the right shoulder and sutured in place. The head and shoulder were held in place by plaster bandages. The flap covered the area very satisfactorily, but several days later it was lost.

June 9, 1925.—A double pedicle flap was outlined upon the back and raised, but the connections at each end were not divided. In three successive stages the flap was prepared for final transference. This was carried out.

The neck was prepared, and in January, 1926, the flap sutured in place, and held in position by the use of sponges and pressure. Three months later, the pedicle of the flap was divided, and the flap sutured to the neck. The result was quite satisfactory and the patient now has free motion in the neck. (Figs. 1 and 2.)

In December, 1926, a buried epithelial (Thiersch) inlay was inserted under the vermilion border of the lower lip. This became infected and the graft was lost. No improvement. October 9, 1932, a small incision was made through this scar. By undermining between the mucous membrane and the orbicularis muscle, a cavity was made which extended beyond the incision at each end. A modeling compound pattern was made approximately the size of the cavity and was inserted through the opening into the cavity. It was then found that the wound could be closed over this model. The model was then removed from the cavity. A full-thickness skin graft was removed from the thigh and sutured over the model with the skin surface towards the mold. The skin graft with model was then inserted into the cavity and the wound closed. Sixteen days later, a new incision was made along the vermilion border through the skin and through the graft. This incision permitted the model to be removed, revealing a new cavity approximately 90 per cent. covered with a full-thickness skin graft. The vermilion

border was then sutured to the skin graft on one side, and the scar tissue and graft on the other side. This corrected the lip eversion.

FIG. 1.—Showing site from which flap was obtained.

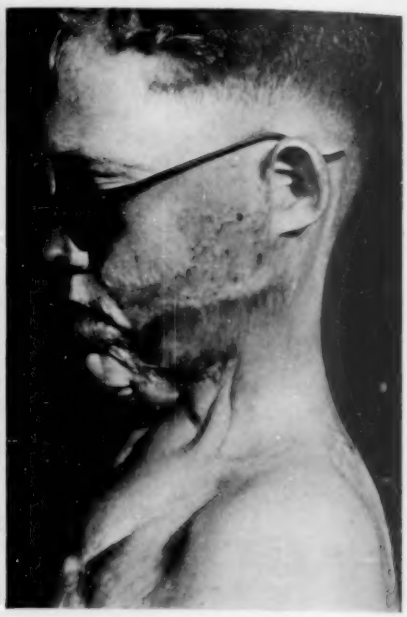

FIG. 2.—Head and neck freed by flap from back; final result.

October 7, 1932, the web in the axilla was corrected by the use of the "Z" incision.

November 5, 1926, a double pedicle flap was raised from the abdomen.

FIG. 3.—Final result from pedicle flap transference.

The scar tissue upon the ulnar surface of the hand which held the little finger in flexion was excised. The finger and ulnar surface of the hand were placed under the flap. The edges of the flap were sutured to the edges of the wound

on the hand and finger. This remained in place for two weeks. The pedicles of the flap were then divided, trimmed, and sutured in place. The final result is a movable finger and hand. (Fig. 3.)

PYLEPHLEBITIS WITHOUT HEPATIC ABSCESS FOLLOWING APPENDICITIS

Dr. E. L. Eliason and Dr. Chas. McLaughlin (by invitation) reported the case of a man, thirty-four years of age, who was admitted to the Hospital of the University of Pennsylvania July 1, 1931, with the diagnosis of acute appendicitis. Three days before admission he had developed abdominal pain which appeared rather suddenly about the umbilicus and remained localized in this region. The following morning he experienced a severe chill accompanied by a high temperature. The admission temperature was 102°, the pulse was 100 and the respirations were 28. The entire abdomen was markedly rigid, especially in the lower quadrant. No mass was palpable. The white blood-cell count was 17,000 and the urine was negative. When the abdomen was opened an extremely large gangrenous appendix was found, extending into the right pelvis. There was a perforation at the base of the appendix with the formation of an abscess, the major portion of which was situated between the leaves of the meso-appendix, although purulent material was present in the pelvis. The meso-appendix was markedly thickened and indurated, this process involving the cæcum surrounding the appendiceal base. On severing the meso-appendix the cut vessels were seen to be definitely thrombosed, confirming the pre-operative impression. The appendix was removed with the cautery after tying the stump. Drainage was then instituted and the abdomen closed.

On the afternoon of the first post-operative day the patient had a severe chill lasting fifteen minutes, during which his temperature rose to 104.6°. The following day there was a similar chill with hyperpyrexia, and during the next eighteen days the patient experienced twelve additional severe chills. The temperature was of a very septic type, ranging from normal or slightly above normal in the mornings to 103° or 105° each afternoon. (Fig. 4.) A chest plate taken on the seventh post-operative day showed a slight elevation of the right leaf of the diaphragm, but the bases of both lungs were quite clear. Fluoroscopical examination of the chest twelve days after operation showed a normal excursion of both diaphragms and there was nothing as yet to suggest hepatic abscess or upper abdominal peritonitis. Abdominal examination showed a slight increase in the resistance of the upper abdomen, particularly on the right, and the liver was now two finger-breadths below the costal margin to percussion. Pain was not a feature, although there was moderate tenderness over the enlarged liver. The leucocytes ranged between 19,000 and 23,000 and the hæmoglobin had fallen from an initial reading of 80 per cent. to 65 per cent. There was no demonstrable jaundice at this time and bile salts did not appear in the urine until twenty-two days following the appendectomy.

Fluoroscopical examination of the chest eighteen days after operation showed a normal excursion of both diaphragms and no lesion in either base. A needle introduced into the left chest posteriorly in the eighth and ninth interspaces yielded nothing. By the same procedure repeated on the right side thirty cubic centimetres of turbid greenish yellow fluid were obtained by aspiration. Exploration of the right lobe of the liver revealed only dark blood in the aspirating needle. A culture of the fluid was negative. The patient continued to run a septic temperature, with a rapid pulse, leucocytosis

of 20,000 and appeared to be very ill. He undoubtedly had a pylephlebitis, probably with hepatic abscess.

Twenty-nine days after the first operation, a needle was again introduced into the lower right chest and thirty cubic centimetres of greenish yellow fluid obtained, similar in type to that found on aspiration at the same site eleven days previously. With a long exploring needle an attempt was again made to locate pus in the right lobe of the liver with no result. A slight degree of œdema of the chest-wall was now present over the right lobe of the liver, especially in the mid-axillary line. Fist percussion was moderately painful at this site. The sclera had a definitely icteroid tint, but there was no jaundice of the skin noted. A moderate degree of emaciation with anorexia and lassitude had become prominent features of the illness.

August 8, 1931, thirty-two days after his appendectomy, exploration of

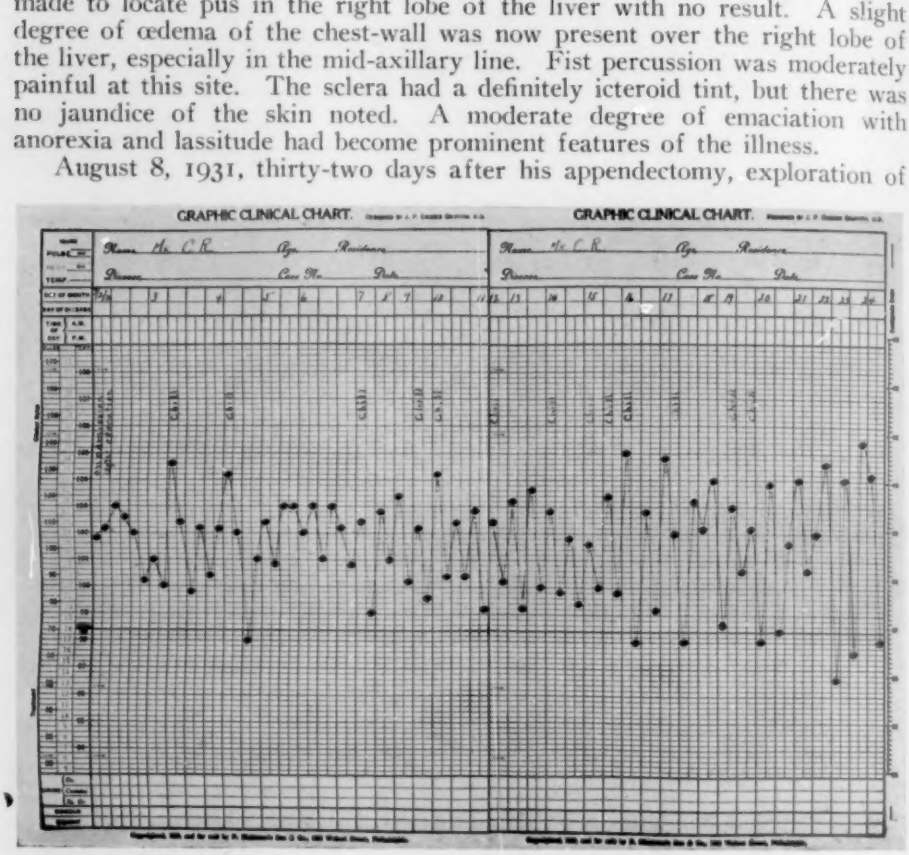

FIG. 4.—Temperature chart during the post-operative period demonstrating its "hectic" character.

the right upper quadrant of the abdomen revealed a moderate amount of yellow, slightly turbid, ascitic fluid in the peritoneal cavity. The liver was engorged, dark purple in color, and extended three finger-breadths below the costal margin. Exploration of the hepatic surface was negative for abscess. Careful palpation suggested the presence of several firm areas lying deep in the right lobe of the liver, considered to be inflammatory in nature. In the region of the common duct there was palpable a firm indurated cord passing down from the liver which represented the thrombosed portal vein. There was a great deal of œdema in this region which had completely obliterated the foramen of Winslow. The posterior peritoneum presented a glazed gray color, typical of œdema, but no thrombosed veins could be identified in the retroperitoneal tissues. The gall-bladder appeared normal. The right lobe of the liver was then explored with a long needle, especially in the suggestive indurated areas, but no purulent material could be obtained. The diagnosis

of pylephlebitis was definitely substantiated, but the presence of liver abscesses could not be proven. No operative procedure could be done that would materially benefit the patient so the abdomen was closed and the patient given 450 cubic centimetres of blood on the table.

Post-operatively the patient reacted quite well, although the temperature continued to be of the septic type, ranging from normal to 103° each day with a leucocytosis of 17,000 to 22,000. There was a rather severe degree of anæmia present at this time with a red blood-cell count of 3.5 million and a hæmoglobin of 58 per cent. Following this exploration, however, the patient ceased to have chills and none was observed during the remainder of his stay in the hospital. Transfusions were given at intervals of two weeks to maintain the red blood-cell and hæmoglobin levels. Two weeks following this exploration a mild left-sided femoral phlebitis developed, the major signs clearing up within seven days. The patient was permitted out of bed twenty-five days after the second operation, although the temperature was still of the septic type with a daily afternoon rise ranging between 101° and 103°. There were no subjective symptoms complained of except marked weakness and a moderate degree of abdominal distention which responded to enemas. Two months after the appendectomy a needle was again introduced into the seventh thoracic interspace on the left posteriorly and a liter of clear straw-colored fluid removed. A culture of this fluid was reported negative. Fluoroscopical examination now showed both diaphragms to be moderately fixed, moving but slightly with coughing.

During the next three weeks the patient's condition in general remained stationary. The temperature remained septic, although the excursion now swung between normal and 101° and the leucocytes had fallen to 13,000. September 25, 1931, one-half liter of fluid was again withdrawn from the left chest, its character identical with that previously removed. Following this second thoracentesis, there seemed little tendency for the fluid to reaccumulate. The patient left the hospital for a nursing home eighty-nine days after his operation for appendicitis. Examination two weeks after leaving the hospital showed the chest almost clear; there had been a weight gain of twelve pounds and a marked general improvement. The temperature was normal when seen and the leucocytes were 7,000. When last examined December 11, 1931, five and one-half months after his appendectomy, there had been a gain of twenty pounds in weight. There was no evidence of portal obstruction. An X-ray study of the chest showed that both domes of the diaphragm moved normally and the lung fields were quite clear. The red blood-cell count was five million, the white blood-cells numbered 6,500 and the hæmoglobin was 90 per cent.

Doctor Eliason added that pylephlebitis with or without hepatic abscess occurs following surgery for acute appendicitis in from .1 to .4 per cent. of all cases. In 1926, he reviewed this subject and found in the literature reports of fifty-three cases of pylephlebitis with liver abscess following appendicitis. Fourteen personal cases were reported, bringing the total number to sixty-seven, with a mortality of 54.4 per cent. Reports of twelve additional cases published since that time have been collected, which, with the case reported here, brings the total number to eighty with a 52.5 per cent. mortality.

A study of the twelve cases recently reported shows that pylephlebitis alone was the complicating factor in five cases, pylephlebitis with associated

hepatic abscess in two cases, and in the remaining five cases only liver abscess was recorded, with no note of an existing pylephlebitis.

The case now reported in some detail represents a case of proven pylephlebitis unassociated with hepatic abscess, recovering after a protracted illness of six months. The pre-operative history of a chill suggested that the infectious process had already extended upwards from the appendix, this being confirmed at operation by the presence of thrombosed appendiceal vessels. The subsequent history of the case was typical, demonstrating practically all of the features commonly associated with this condition. Boggy œdema, pitting with difficulty, was noted in the mid-axillary line opposite the tenth rib on the right in this case, offering further evidence that this is a diagnostic point of importance. Pain was not a marked feature, but icterus of mild degree, hepatic tenderness, nausea and vomiting, lassitude, anorexia and emaciation were all evident features. In this case, X-ray studies of the patient at frequent intervals were of great assistance in following the course of the illness. Great importance is now placed upon the roentgenological examination of the diaphragm and chest. In a recent paper Doctor Pancoast has described in detail the X-ray aspects of pylephlebitis and liver abscess. Although operation demonstrated the portal vein to be thrombosed, ascites of definite degree did not develop, confirming the observation formerly made that ascites rarely develops with pylephlebitis following appendicitis.

Liver abscesses could not be demonstrated in this patient, although the liver was thoroughly inspected at operation and explored with needles. The later development of a left-sided pleural effusion suggested that the left side of the liver might have been the affected side, yet the subsequent complete recovery of the patient leads one to believe that hepatic abscesses were never present. It has been observed that single abscesses occur in the right lobe of the liver in over half of the affected cases, and in these surgery offers relief, while multiple abscesses usually involve the left lobe or the entire liver, offering little from a surgical standpoint.

There has been considerable discussion concerning the correct method of handling pylephlebitis in those cases in which the diagnosis can be made at the time of the appendectomy. Incision or excision of the thrombosed ileocolic veins before performing the appendectomy has been advocated by Gerster, Wilius and Braun. Neuhof has suggested ligation of the portal vein, this having subsequently been done in four cases by Colp with a mortality of 75 per cent. The later author has abandoned this procedure and suggests that resection of the ileocolic veins at the time of the appendectomy would seem the more safe and rational procedure in those cases in which this is technically possible. Pylephlebitis having developed, surgery can be of help only in the advent of the development of a hepatic abscess so situated that it may be approached and drained. The frequency with which these abscesses appear as a large solitary collection of pus in the right lobe of the liver makes the transthoracic approach the method of choice. In those cases

in which drainage can be instituted, the results are very gratifying and these constitute approximately 47 per cent. of the reported cases developing hepatic abscess following appendectomy.

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CARCINOMA OF BOTH LEGS SUPERIMPOSED UPON CHRONIC OSTEOMYELITIS

DOCTOR ELIASON and DR. CHAS. MCLAUGHLIN reported the case of a man, thirty-four, admitted to the Hospital of the University of Pennsylvania May 3, 1932, with large ulcerating lesions on the anterior surfaces of both legs. At the age of six he had suffered compound fractures of both tibiæ. Although union occurred, since that time draining sinuses had repeatedly appeared at the fracture sites, bits of bone being discharged from each at intervals of three or four months.

Six months before admission the patient received a blow on the anterior surface of the left tibia, following which spicules of bone were again discharged. The draining sinus did not heal as in the past, but persisted and increased in size, until a dirty, ulcerated area four inches in diameter was present at the site of the old injury. At the same time, a draining sinus on the anterior surface of the right tibia began to increase in size, presenting an area similar in appearance to that on the left leg, and measuring 2.5 inches in diameter. During the two weeks before admission the patient had suffered with pain in both legs, making walking difficult and interfering with his rest. There had been a weight loss of fifty pounds during the past six months. He was a large, well-developed and nourished man in spite of the history of recent weight loss. On the anterior surface of the left leg, beginning just below the tibial tubercle, was a huge ulcer, measuring eight by five inches in its two diameters. The surface was necrotic and there was an abundant thin purulent discharge with a foul odor. The granulation tissue, which was especially prominent about the edges of the ulcer, was pale and

œdematous. The margins were elevated and rolled, small dilated veins being evident in the elevated edges. A similar lesion was evident on the inner aspect of the middle third of the right leg, measuring five by three inches. Extensive scarring was present about both of the ulcerated areas, suggesting the appearance commonly seen in a chronic osteomyelitis of long duration. (Fig. 5.) Bilateral inguinal adenopathy was present, being more marked on the right. The glands were firm, freely movable and not tender.

X-ray examination of both legs showed marked deformity of the bones, the result of chronic osteomyelitis. An active infection could not be excluded from these plates, however, nor could a positive diagnosis of neoplastic involvement of the bones be made. (Fig. 6.) A chest ray was negative for evidence of metastasis.

Biopsy of both ulcers was performed May 4, 1932. These were reported

FIG. 5.

FIG. 6.

FIG. 5.—Appearance of the lesions on admission.

FIG. 6.—X-ray plate of tibia on admission. The appearance is typical of long-standing osteomyelitis. No definite diagnosis of neoplastic involvement of the bones could be made from these plates.

to show squamous-cell carcinoma, graded I, in the Broders classification. Because of the extent and nature of the lesions, amputation was decided upon and advised.

Under spinal anæsthesia, the left leg was amputated at the junction of the middle and lower third May 9, 1932. Examination of this specimen showed the tumor to be involving the bony tissue. (Fig. 7.) The stump healed by primary union. The ulcer on the right leg was meanwhile treated with dressings of balsam of Peru in an effort to decrease the odor incident to the foul discharge.

May 23, 1932, a disarticulation of the right knee-joint was done under spinal anæsthesia, the patient reacting well from this procedure. Examination of this limb after operation demonstrated that the tumor here was invading the bone also. Convalescence following this second operation was

interrupted by a wound infection which appeared on the eleventh post-operative day. A pocket of pus was found under the anterior skin flap. A hemolytic streptococcus was cultured from this. Subsequently the patient did well, the wound healing satisfactorily by granulation tissue. He was discharged June 21, 1932, the left stump being well healed and the right stump presenting a clean granulating area six centimetres in diameter. Six weeks later he was readmitted for a course of deep X-ray therapy to the inguinal regions. He had gained fifteen pounds and was free from all pain or discomfort. On this admission it was impossible to palpate any enlarged inguinal glands. During this period several skin grafts of the Reverdin type were placed upon a small granulating area still present on the right stump. He was discharged with his right stump becoming epithelized August 11, 1932.

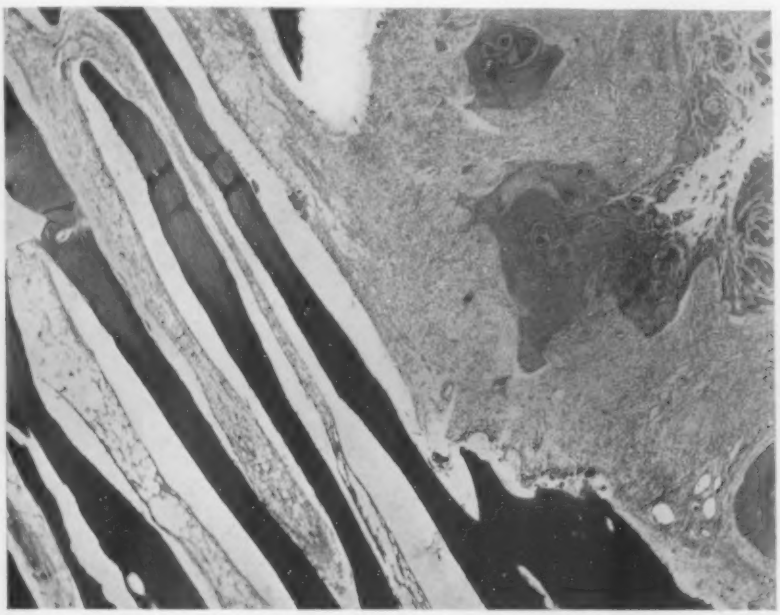

FIG. 7.—Photomicrograph of section of the tumor. Actual invasion of the bone is here evident.

A note from the patient October 3, 1932, stated that both stumps are well healed; he is entirely free from pain and feeling well.

DOCTOR MCLAUGHLIN remarked that carcinoma arising in osteomyelitis has been recognized for many years, being first described by Hawkins in 1833. Bennett has recently reviewed the entire subject, reporting a series of ten cases from the records of the Massachusetts General Hospital. In a series of 2,400 cases of osteomyelitis, this author found twelve cases of malignant degeneration. All of the patients were middle-aged males with a history of long-standing draining sinuses. In 66 per cent. of the cases the lesion appeared engrafted upon an osteomyelitis of the tibia.

The history of the patient presented above is quite typical of the entire group. Pain, which is usually a prominent feature, was present here in a marked degree and there was a definite history of trauma prior to the development of the malignant ulcer. The unusual feature of this case is its bilateral character, both lesions appearing within a few weeks of each other. Such a case certainly speaks for the rôle played by long-standing chronic inflammation in the development of malignant disease.

This form of tumor is usually slow-growing and the results following amputation have been quite satisfactory. In our case the fact that the glands present on the first admission were not palpable when the patient was readmitted six weeks later, suggests that this adenopathy may have been the result of the chronic inflammation and not of neoplastic involvement. The fact that malignant degeneration does occur in chronic draining osteomyelitic sinuses stresses the necessity of making every effort to heal all such sinuses whenever possible.

BILATERAL OSSIFIED HEMATOMA AT THE ELBOW

DOCTOR ELIASON reported the case of a woman, aged thirty-five, admitted to the Philadelphia General Hospital May 18, 1932, with a diagnosis of paresis. Four days before she became suddenly deranged. On admission to the hospital she was violent and had to be restrained for a matter of six weeks during her stay. During the first few days she had several venous punctures, all in the anti-cubital spaces; also intravenous typhoid antigen inoculations.

The patient was seen by the reporter June 16, 1932, just four weeks from the time of admission. Examination disclosed hard, firm swellings in both anti-cubital spaces. A diagnosis of ossified hematomata was made and confirmed by X-ray examination the following day. She was given physical therapy with resultant marked improvement in the left arm. The right arm did not respond at all, and on discharge from the hospital she had no motion in the elbow-joint whatever.

X-rays taken fourteen weeks after the onset showed entire disappearance of the shadow in the left arm, but the right arm disclosed an increased density of the previous shadow which is described by the röntgenologist as being a marked increase in the ossifying process resulting in ankylosis of the elbow-joint. In this case there was no fracture or dislocation associated with it; it is bilateral, which is very unusual, and one elbow has completely recovered but the other has gone on to complete ankylosis.

DR. BENJAMIN LIPSHUTZ remarked that the general thought on myositis ossificans is that it rarely occurs in women. Those seen by the speaker have all been in males. Another point worthy of emphasis is the keeping away from any active movement in these cases. Massage and use of heat only increase calcification. Therapeutically puncture of the initial hematoma does not inhibit the subsequent calcification. The history of many cases followed is that some progress satisfactorily to recovery; in others the calcification remains stationary. The calcium in the muscle tissue is not true bone. A very careful study of calcium as related to bone development and as related to different pathological processes has shown that in bone development calcium is largely the result of secretory activity of the osteoblasts and in myositis ossificans it is due to the precipitation of calcium salts in the tissues.

DOCTOR ELIASON rejoined that the pathologist reported true bone with Haversian's systems in a specimen that he removed. One other writer has mentioned this fact and previous to his observation this lesion was spoken of as a calcified hematoma. Latterly it has usually been designated as an ossified hematoma.

EXTERNAL GASTRIC FISTULA

DR. NORMAN S. ROTHSCHILD reported the case history of a man, aged twenty-nine years, admitted to the accident ward of the Graduate Hospital

at 5 A.M., May 15, 1931, with the history of having eaten some doughnuts at 3 A.M. At 4:30 A.M. he was seized with sudden severe pain in the epigastric and right hypochondriac regions, but did not vomit. His temperature was 95.2°, pulse 72 and respiration 20. The anterior abdominal wall above the level of the umbilicus had a board-like rigidity. His skin was cold and covered with perspiration, the pupils were equal and reacted to light and accommodation. Otherwise the physical examination was negative. It was elicited that about a year previous he had an attack of indigestion which lasted two or three weeks and consisted of epigastric pain, acid regurgitation, belching, but no vomiting. This pain was increased by the taking of food and relieved by bicarbonate of soda. One week before admission the pain returned but had no relationship to the taking of food and was relieved by "Caroid." He had not been constipated nor was he conscious of having had bloody or tarry stools. There was no history of jaundice.

He was operated upon two hours after admission to the hospital. An upper right rectus incision into the peritoneal cavity disclosed an œdematous pylorus with a perforation on the anterior surface of the stomach about one inch proximal to the pylorus. Considerable gastric contents were found in the peritoneal cavity. Three mattress sutures of fine chromic catgut were used to close the perforation, but it was impossible to cover the wound with serosa because of the œdema of the tissues; a portion of the great omentum was therefore amputated and sutured over the site of the perforation. Suprapubic drainage was finally established.

During the first twenty-four post-operative hours his temperature gradually rose to 102.2° and the respirations to 48, with considerable respiratory embarrassment. After the giving of 10 per cent. carbon dioxide and 90 per cent. oxygen for a period of fifteen minutes every two hours a productive cough was established which resulted in the expectoration of a moderately thick sputum, and upon the establishment of this expectoration the patient's condition improved. On the fourth post-operative day, although the physical signs showed marked re-aëration of the involved lobes of the lungs, pneumonia developed in the base of the right lung. The temperature remained around 101°, but the pulse and respirations became slower. The abdominal wall was soft and there was a slight serous discharge from the suprapubic drain. His general condition was satisfactory.

May 24, the tenth post-operative day, the dressings became soaked with a sour-smelling, faintly yellow-colored fluid. This was found to be acid in reaction and it caused a mild irritation of the skin adjacent to the wound. An attempt was made to pass an Einhorn tube through the pylorus into the duodenum, but this failed, the tube not passing beyond the site of the perforation, and although it was attempted under the fluoroscope, no success was obtained until a beaded shot was passed into the duodenum to which a silk thread was attached. The other end of this silk thread was fixed to the end of the Einhorn tube and in this way the jejunum was entered. The position of this tube was verified by X-ray examination. The patient was fed every two hours from 8 A.M. to 8 P.M., his feedings consisting of eight ounces of orange juice, milk or broth. After each milk feeding eight ounces of saline was given.

On the fourth day following the insertion of the tube the drainage from the fistula had ceased. The tube was allowed to remain in the jejunum for sixteen days, when he was discharged from the hospital to receive further care in the gastro-intestinal clinic.

During the summer he had a return of the pain and for this he was admitted to the Philadelphia General Hospital, in Doctor Owen's service,

September 8, 1931. Two days later, under spinal anæsthesia, an upper right rectus incision was made into the peritoneal cavity. A few adhesions were noticed around the pylorus and a distinct fibrous tract running from the site of the ulcer on the pre-pyloric portion of the stomach to the anterior abdominal wall. A posterior gastroenterostomy was made and the fistulous tract was dissected from the abdominal wall and the anterior wall of the stomach by means of the actual cautery. The raw surface was covered by serosa. Uneventful recovery followed this operation and he was discharged from the hospital September 26. He reported for active duty November 12, 1931, and has been symptom-free since.

THE TREATMENT OF INTERCOSTAL NEURALGIA OF THE ABDOMINAL WALL

Dr. J. B. Carnett and Dr. William Bates read a paper with the above title.

Dr. S. Dana Weeder called attention to causes remote from the abdominal cavity which may cause abdominal pain.

Mackenzie has described what he believes to be the mechanism of the reflex which causes hyperalgesia of the skin and contraction of the intercostal muscles of the pre-cordial area and referred points in heart disease. In brief, he states that abnormal conditions in a hollow viscus with a muscular coat set up a stream of nervous energy through the sympathetic nerves which cause an irritable focus in a segment of the cord which spreads over the sensory fibres going to the brain which are interpreted by the brain as pain or hyperalgesia of the skin at the peripheral distribution of the nerve which is usually over the affected viscus and if spread over the motor area to cause spasm of the muscles of the parieties overlying the affected viscus.

These reflex phenomena furnish us with most valuable diagnostic aids—localized pain, tenderness and rigidity—over an affected viscus. He also points out, which has been demonstrated by all surgeons, that a viscus may be handled without pain but pinching, twisting, pulling, distention or hyperperistaltic waves will cause pain.

It is possible, therefore, that deep pressure may be exerted upon a diseased viscus, the mixed nerves of the parietal wall having been paralyzed by novocaine injection, without giving pain or increased resistance and an erroneous conclusion then being drawn that there is no disease of the underlying viscus.

This reflex the speaker believes accounts for the pain, tenderness and increased muscular resistance of the upper right abdomen in gall-bladder disease; of the lower right abdomen in appendicitis and the backache in a large percentage of pelvic conditions. It certainly seems impossible for direct pressure by a displaced uterus, small tumors, cysts or some cases of salpingitis to exert pressure upon the sacral plexus which in most instances cannot be demonstrated at operation or autopsy. The same reflex as before described must again be the true explanation of the backache suffered so commonly by these patients.

DR. HUBLEY OWEN said that from personal observation at the Philadelphia General Hospital during the past few years he had observed the effect of Doctor Carnett's teaching on the question of intercostal neuralgia. He believed that his theory is being overemphasized to a dangerous degree. Undoubtedly we can have neuralgia of the intercostal nerves with referred pain and hypersensitiveness of the abdominal wall but the minds of the internes as well as medical students have been confused by the overemphasis of this condition.

The speaker had had three cases at the Philadelphia General Hospital diagnosed as intercostal neuralgia, two of which were cases of very acute appendicitis and one of calculus cholecystitis. The mortality of appendicitis is too high. Delay in operation for appendicitis is the cause of the high mortality. Do not let us make further confusion in the minds of the internes and students by any overemphasis of intercostal neuralgia.

DR. BENJAMIN LIPSHUTZ said that the use of the label intercostal neuralgia for such a wide range of disturbances seems too inclusive. It is much like the term chronic abdomen that was used many years ago by Hutchinson. All symptoms wherever possible should be interpreted on basis of known anatomical and physiological data. Every sensory impulse, including pain, has its cell body in the posterior root ganglion.

The nerve supply of the abdominal wall and of the parietal peritoneum is segmental with varying degree of nerve overlap. Similar segments of the abdominal wall and of the parietal peritoneum are supplied by the same sensory fibres. True visceral pain, on the other hand, is felt deep in the abdomen, cannot be accurately localized, and is mediated probably by means of separate pathway, which extends only to the thalamus, thus accounting for the vague localization that occurs with true visceral pain. The visceral organs are governed only by the diencephalon. Admittedly the exact course of the visceral or sympathetic afferents are not accurately known. Recently Kuntz has demonstrated the presence of visceral or sympathetic afferents in the gray rami of the lumbar nerves. It would appear, therefore, that many cases included under caption of intercostal neuralgia unless clearly segmental must be classified more accurately.

DR. HENRY P. BROWN, JR., believed that it is unsafe to place too much stress on the diagnosis of intercostal neuralgia in the presence of acute or subacute abdominal symptoms, especially when these symptoms and signs indicate appendicitis. In view of the fact that in Philadelphia the yearly mortality from appendicitis is increasing in spite of propaganda directed toward both the profession and laity, and apparently the only way to reduce this mortality is by early diagnosis and removal of an appendix which is causing symptoms, be they mild or severe, it seems that should Doctor Carnett's views in this matter be generally accepted, many cases of appendicitis will be overlooked in the stage when appendectomy should be a compara-

tively minor operation, and will only receive surgical relief in that stage when the mortality figures are unfortunately so high.

It would appear that it is better to occasionally remove a doubtful appendix in the presence of intercostal neuralgia than to subject the patient to the risk of perforation and its sequelæ through failure to recognize an appendix, which though the symptoms may be mild at the outset, is such a potent fact for serious consequences.

Dr. Walter G. Elmer remarked that pain referred from the spinal column to the anterior portion of the thorax and abdomen has long been stressed in teaching students in order to avoid mistakes in diagnosis. The spine may be diseased and this may reflect the pain to the termination of the nerve trunks. The spine may be out of line and the unnatural strain thrown upon ligaments and muscles may be reflected along the nerve trunks to some distant region. It requires a very severe deformity of the spinal column or an injury to the spine to cause compression of the nerve trunk in the intervertebral foramen as the diameter of the foramen is much greater than that of the nerve trunk. It is about equivalent to passing a lead pencil through a finger ring. Infectious processes about the articulations of the spine, such as gonorrhœa, for example, may cause the deposit of inflammatory exudate, fibrous connective tissue, exostoses and periosteal thickening which may so encroach upon and imbed the nerve trunks that referred pain will result. Not only is pain referred along the nerve trunk to its distant branches but the nerve and its branches may become exceedingly hypersensitive and tender. This is then both a neuritis and a neuralgia and the clinical picture may be described as radiculalgia. This condition has of course long been recognized. The undoubted value of the studies of Doctor Carnett and Doctor Bates in this field lies in the fact that mistakes have frequently been made in diagnosing the cause of abdominal pain. They demonstrate very clearly how easily intercostal neuralgia may be mistaken for intra-abdominal inflammation or disease and they point out very clearly how these mistakes can be and should be avoided.

Dr. J. B. Carnett remarked that Doctor Weeder is an advocate of the Mackenzie viscerosensory theory which the former unqualifiedly and wholeheartedly condemned as being absolutely erroneous and misleading. The Mackenzie theory is promulgated mainly by the medical men. The vast majority of thoughtful surgeons have had ample opportunities at operation on abdominal lesions to determine the fallacies of the viscerosensory theory and do not believe in it as applied to the abdominal viscera. Unfortunately, operations on the thoracic viscera are not available to demonstrate its inaccuracy as applied to them. However, he has had many opportunities of examining patients in the midst of acute pain attacks of acute coronary thrombosis and of angina pectoris without evidence of coronary disease and in the absence of a coincident neuralgia has found the acutely painful areas entirely free from tenderness by the most vigorous possible pinching, by

pin pricking or stroking, and by firm poking palpation. He has seen a sufficient number of cases now to be convinced that any tenderness found during an angina attack is due to an associated neuralgia which is in no way dependent on a cardiac or aortic lesion. In other words, the presence of superficial tenderness neither proves nor disproves the existence of a cardiac or aortic lesion nor of an abdominal visceral lesion. Parietal neuralgia may exist alone or in association with any chest or abdominal lesion but the tenderness of neuralgia should never be mistaken for visceral tenderness either directly or indirectly on the basis of Mackenzie's viscerosensory theory. He further did not agree with Doctor Weeder's assumption that muscular rigidity and superficial tenderness are due to an identical mechanism. Either of these two symptoms may be found in the absence of the other in numerous patients.

He has found by abundant experience that novocaine injections of the abdominal wall or parietal nerve trunks do not abolish visceral tenderness. They do abolish the parietal pain and tenderness of neuralgia and permit proper evaluation of symptoms or lack of symptoms indicative of visceral disease. The frequent failures to overcome the backache and widespread pain and tenderness by operative correction of the pelvic lesions to which Doctor Weeder refers indicate that these symptoms were due to other causes, probably postural spinal stresses and the neuralgias so commonly accompanying them.

He strongly disapproved of needless operations which Doctor Owen and Doctor Brown evidently regard as of minor importance. The judgment of internes as to the necessity for or against operation is not a proper criterion by which to determine the value of new methods of diagnosis with which their own chiefs may not be familiar. He recalled having examined two patients with supposed acute appendicitis with Doctor Owen and demonstrated one had it and the other did not as Doctor Owen found at operation upon them before his class but the latter frankly stated his inability to explain how the correct pre-operative diagnoses had been made. A better understanding of neuralgia would have obviated the needless removal of that innocent appendix.

He agreed with Doctor Lipshutz that true visceral pain is felt deep in the abdomen but he further issued the warning that the majority of neuralgia patients when asked if their pains are superficial or deep will reply that they are deep seated.

It is true as Doctor Owen and Doctor Brown suggest that internes and general practitioners may withhold operation in urgent cases of acute appendicitis on the assumption that all the symptoms are due to neuralgia. They do the same thing on a mistaken diagnosis of acute pelvic inflammatory disease for which operation is contra-indicated but that does not constitute a reason for condemning a diagnosis of salpingitis because it might increase the mortality rate in acute appendicitis. The obvious need is better training both in salpingitis and parietal neuralgia. Lacking that the inexperienced should refer all doubtful cases to the surgeon for decision and the latter

should feel the same chagrin for a needless appendectomy in parietal neuralgia as in acute salpingitis. The acute neuralgias which simulate acute appendicitis occur most commonly in the later stages of a respiratory-tract infection when a general anæsthetic is not entirely free from danger.

Unfortunately, the needless operations brought about by the failure to recognize parietal neuralgias are not restricted to the occasional appendectomies to which Doctor Brown refers. It is not uncommon to see patients who have had three or more—up to a dozen—operations of varying grades of severity, some of which were attended with grave mortality risks and who continue to have their original pain and tenderness caused by parietal neuralgia.

POST-OPERATIVE URINARY RETENTION

Dr. Claus Jordan, by invitation, read a paper with the above title for which see Annals of Surgery, vol. xcviii, July, 1933.

BRIEF COMMUNICATION

X-RAY DIAGNOSIS OF COMMON DUCT STONES

THE difficulty in visualizing common duct stones by X-ray, even with lipiodol, is well known. The two case reports by Ginzburg in the ANNALS OF SURGERY September, 1932 (vol. xcvi, p. 474) have prompted us to report a case which not only showed two stones with lipiodol injection, but actually on the flat plate before injection. (Fig. 1.) This case emphasizes the advisability of a careful exploration of the common duct when the preoperative X-ray findings suggest the possibility of stone, even when there is no history of jaundice. Had the common duct been more carefully explored, the second operation would probably not have been necessary.

FIG. 1.—Arrows indicate two common duct stones on flat plate.

Miss P. V., aged thirty-five, entered the hospital August 15, 1931, complaining of colicky pain in the right upper quadrant in attacks associated with epigastric fulness for five months, never with jaundice. Her last attack began six days prior to admission with sudden sharp cramping epigastric pain which persisted for several hours, associated with gas, nausea and vomiting and relieved only by opiates. The attack gradually subsided but tenderness over the right upper quadrant persisted.

A flat plate of the abdomen (Fig. 1), August 15, 1931, showed a "gall-bladder partially outlined with numerous small stones in the gall-bladder. There were two stones in the cystic duct and one shadow in the region of the common duct." August 18, 1931, a cholecystectomy was performed. In view of the X-ray report, a probe was passed through the open cystic duct, but no stone was felt in the common duct.

Post-operatively, the patient became moderately jaundiced and poured bile from the wound constantly. The stools were bile-free. Three weeks after operation, lipiodol was

injected into the sinus tract and two common duct stones were seen by X-ray. "The hepatic and common ducts filled readily down to the first stone and after fifteen minutes a small amount of lipiodol passed the first stone, down to the second stone. None reached the duodenum."

Second Operation.—October 15, 1931, through the former wound the common duct was exposed and opened. The first stone was readily removed through the incision in the common duct but the second was impacted at the ampulla of Vater and necessitated a transduodenal approach. The stone was pushed back up the duct and removed. Two stones were also removed with a scoop from the hepatic duct. A transfusion of 500 cubic centimetres was performed during the operation. The abdomen and common duct were drained.

LON GROVE, M.D.
JOSEPH C. READ, M.D.
Atlanta, Georgia

MEMOIR

GEORGE HOWARD MONKS, M.D.

1853-1933

IN THE death of Dr. George Howard Monks January 6, 1933, the surgical profession of our country and his native New England lost a man whose place, both as a man and a surgeon, it will be hard to fill. Primarily he was

GEORGE HOWARD MONKS, M.D.

an artist, and everything he did in his profession was marked by an artistic skill peculiarly his own. He had spent many laborious years in teaching in the Harvard Medical School, especially in the Department of Surgical Anatomy in which he always showed a special interest. He had done much

work in plastic surgery and contributed a great deal to that subject. He wrote on operations for correcting deformity due to prominent ears, unilateral laryngectomy for carcinoma, spiral fractures of the humerus, flushing of the intestinal canal through multiple enterostomy openings, plastic operations on the nose by Tagliacozzi's method, and many other subjects. His work on intestinal localization, which he perfected by long study on the cadaver, was one of his most important contributions. In this he demonstrated that a coil of the small intestine presenting through any small incision in the abdomen could be closely localized by its physical characteristics so that its availability for low or high enterostomy could be determined without the formidable process of exenteration and going over the whole length of the bowel to see what part of the bowel presented. He also demonstrated that the entire small intestine could be strung on a straight rod or tube, a discovery which Lord Moynihan afterwards employed in devising his long straight tube for emptying distended coils of intestine in obstruction. This was the subject of the Mütter Lecture before the College of Physicians of Philadelphia in 1905. He published in all fifty-six papers, including biographical sketches of contemporary surgeons. One of the best was entitled Selections from the Medical Writings and Sayings of Doctor Oliver Wendell Holmes.

Doctor Monks was born in Boston, March 28, 1853, son of John P. and Delia S. (Hatton) Monks. He prepared for college at Boston Latin School. He was graduated from Harvard College in 1875 and entered the architectural department of Massachusetts Institute of Technology, where he studied during the following year. He then decided to study medicine and entered the Harvard Medical School, from which he was graduated in 1880. After a year of surgical interneship at the Massachusetts General Hospital, Doctor Monks studied further for four years at Vienna, Leipzig, Heidelberg, Dresden, Paris and other continental medical centres. At the end of this period he passed examinations admitting him as a member of the Royal College of Surgeons of England.

He began the practice of surgery in Boston in 1884, and was appointed district physician of the Boston Dispensary and, later, visiting surgeon to the Carney Hospital. In 1890, he entered the Boston City Hospital and was promoted through various grades to surgeon-in-chief in 1910. He resigned in 1914 and was appointed consulting surgeon.

From 1886 to 1914 Doctor Monks was connected with the Harvard Medical School, resigning after lecturing on surgery at the school for eleven years. From 1886 to 1926 he was connected with the Harvard Dental School, and in those forty years he provided a valuable link between the Medical and Dental Schools. When he resigned he was Professor of Oral Surgery. He was appointed a professor emeritus.

He was at various times chairman and secretary of the surgical section of the Suffolk District Medical Society, president of the Suffolk District Medical Society, president of the Boylston Medical Society, vice-president

of the American Surgical Association, fellow of the American Medical Association, fellow of the American College of Surgeons, first president and co-founder of the Boston Surgical Society, senior member of the New England Surgical Society, president of the Boston Medical Library, Boston Society of Medical Sciences, American Medical Association, Massachusetts Medical Society, and the Boston Society for Medical Improvement.

During the recent war, being over age for active service, he was a member of the volunteer medical service corps and division medical adviser for the Red Cross.

It will be noted in the above account that he spent four years studying in European medical centres. In the autumn of 1883, while visiting his brother Robert in France, and preparing for the examination of the Royal College of Surgeons, he invented the game called "Halma," which was successfully introduced in this country by Dr. Thomas Hill of Portland, Maine, and later was manufactured and sold extensively in this and many foreign countries.

I cannot forbear introducing at this time a brief account of his avocations, taken from a sketch of his life which he himself wrote:

"I have had a number of 'hobbies,' to which I have given a good deal of attention, especially after retiring from active professional work. Perhaps the principal of these was sculpture, in connection with which I have modeled a number of subjects. It is pleasant to remember that my contribution to the Art Exhibition, held at the Tavern Club in 1886 for non-professional members (a small female head which I had modeled in red wax), received the first prize—'Le Grand Prix,' as it was called. Other pieces of amateur work were a bust of Mr. George Augustus Peabody (which was subsequently enlarged by Mr. John Wilson, and then put into marble, for the Peabody Museum at Salem, and another marble bust—a replica—for the Peabody Institute at Danvers); and also a small bust of Mr. George A. Gardner. My largest and perhaps most important work in the line of sculpture was a dancing figure, in bronze, for our little fountain at 'Briarwood.' I have also made a number of book-ends: among them a pair (in bronze) for Holmes Hall at the Boston Medical Library, after designs selected by the Librarian, Mr. James Ballard, from medical incunabula; another pair (in plaster) representing a man and a woman—for my friend—the late Dr. Morton Prince, and a replica of these for my wife; still another pair (in green bronze), being an attempt to make portraits of our two dogs, 'Zip' and 'Carina'."

On hospital and teaching staffs Doctor Monks was an ideal colleague—modest, kindly, and ever appreciative of the work of his younger associates, to many of whom he gave unstinted help. He was one of the most unselfish men that have ever lived. Every instinct was that of a gentleman, and, I may add, of an artist, and his own profit or advantage was the last thing of which he thought. In personal appearance he was strikingly handsome, nor did his appearance belie his character. As he grew older and gradually

retired from professional work he continued his artistic activities, and found in them joy and satisfaction, until nearly the end of his peaceful and fruitful life.

He was the founder of the Boston Surgical Society, and his influence induced the late Dr. Sturgis Bigelow to endow the Bigelow Medal, which has been presented to many distribuished surgeons in this country and abroad, for contributions to the art and science of surgery. He was greatly interested in and made many contributions to the Boston Medical Library.

He was married to Miss Olga E. Gardner in 1897. He leaves his wife, and three children: the Rev. George Gardner Monks, headmaster at the Lenox School; Dr. John Peabody Monks, a physician in Boston, and Miss Olga Monks. He also leaves a sister, Mrs. Walther Hempel of Dresden, Germany.

Such is a brief outline of the career of an eminent surgeon, and consummate artist. Rare indeed was the spirit of the man, and altogether lovely. To those who knew him intimately his memory will ever be a bright spot among the chequered experiences of their lives. Words fail in any attempt to depict his character. The writer can only regret that the only way to really appreciate him was to know him, and be thankful for his own delightful association with him for so many years.

FRED B. LUND

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